SCIENCE ABSTRACTS.

Section A.—PHYSICS.

APRIL, 1931.

GENERAL PHYSICS.

1062. Action of Certain Gas Blowers. G. Bozza. *Accad. Lincei, Atti*, 12. *pp.* 136–141, *Aug.*, 1930.—A description is given of an apparatus intended to serve for the reaction between a gas and a liquid. This functions under the conditions considered in a previous paper [see Abstract 1 (1931)], and the theory is further discussed. J. J. S.

1063. Microbalance of New Design. G. R. Stanbury and N. Tunstall. *Journ. Sci. Instruments*, 7. *pp.* 343–349, *Nov.*, 1930.—A new form of microbalance developed for noting the change in weight of fine filaments of wool and the like is described. The principle involved is that the centre of mass of the beam is above the horizontal plane containing the axis of rotation, thus giving an inverted pendulum effect. Details of the theory of the instrument are given, and notes on its practical construction. S. G. B.

1064. Apparatus for Experimenting with Gases at High Pressures up to 6000 Kg. per Sq. Cm. J. Basset. *Comptes Rendus*, 191. *pp.* 928–931, *Nov.* 17, 1930.—In the first apparatus described one or more gases can be continuously introduced at high pressure into a reaction chamber which is heated electrically. It is proposed to experiment with a similar apparatus with which a pressure of 10,000 kg. per sq. cm. can be obtained. Another one for studying the compressibility of gases at high pressures is described. The gas is introduced under pressure into a strong steel tube into which fits a piston. This piston is attached in line to another piston of much greater area, and is pushed into the gas tube by liquid pressure acting on the surface of the second piston. The resulting movement can be observed on a vernier, and the pressure in the gas can be calculated from the liquid pressure measured by an ordinary manometer. H. N. A.

1065. Clarity of Expressions in Technical Writings. A. Schack. *Zeits. f. techn. Physik*, 11. 12. *pp.* 547–549, 1930.—A reasoned plea for the exact statement of definitions and units in quoting general formulæ. It is pointed out that dimensionless formulæ may be misleading if, for example, density and specific gravity are not carefully distinguished from each other. J. H. A.

1066. Fitting Observations to a Curve. N. Campbell. *Phil. Mag.* 10. *pp.* 745–758, *Nov.*, 1930.—The simplified method of curve-fitting described by Condon, Birge and Shea, based on the method of least squares, is shown to be equally applicable to the author's method of zero sum, the relative advantages of the two methods being unchanged by the simplification. Tables are given for use in the simplified method of zero sum. W. S. S.

1067. Ridge at the Junction of Two Liquid Surfaces of Different Surface Tensions. J. Satterly and W. D. A. Douglas. *Roy. Soc. Canada, Trans.* 24. *pp.* 87–105, *May*, 1930.—The theoretical equation for the form of the meniscus of a liquid in contact with a vertical surface has been verified by photographing the curve. The ridge at the junction of two liquids of different surface tensions is nearly symmetrical, and its form depends principally on the nature of the liquid wetting the plate. The weight of the ridge has been to some extent correlated with the interfacial surface tension of the liquids. The shape of the ridges formed by various pairs of liquids has been studied by measurement of the distances between successive interference fringes; miscible liquids yield definite ridges, possibly because the mutual solubility becomes very small with very thin films. Indistinct interference fringes have been observed with the disc ridge. H. F. G.

1068. Structure and Viscosity of Rubber Solutions. B. Dogadkin and D. Pewsner. *Kolloid Zeits.* 53. *pp.* 239–245, *Nov.*, 1930.—It is found that if rubber solutions are allowed to flow through a capillary tube under different pressures (in a Wilk-Ostwald viscometer supplied with a manometer according to Wo. Ostwald), these show, in accordance with previous workers, a characteristic deviation from the Hagen-Poiseuille law for colloids. The dependence of the relative viscosity of rubber solutions on the rate of flow or pressure can be expressed by the formula of Waele-Ostwald $\eta = kP^{1-n}$. J. K.

1069. Determination of Aerodynamic Fields of Two and Three Dimensions by Means of the Electric Tank. C. Ferrari. *Accad. Sci. Torino, Atti,* 65. 4–6*a*, *pp.* 75–85, 1929–1930.—Founded on the analogy between plane aerodynamic fields in an incompressible fluid and plane electrostatic fields in a homogeneous dielectric, and the similar analogy between aerodynamic fields of three dimensions and fields of an electric current in a homogeneous conductor, the author describes his experiments for determining the flow in aerodynamic fields. The electrostatic field is set up in water contained in a tank and is explored by electrodes of nickel-chrome wire. Similarly for the flow in aerodynamic fields of three dimensions, the field of the electric current was formed in the water in the tank. The results of the exploration of the fields are given in tables and diagrams. The determination of the equipotential surfaces in a field of three dimensions was carried out with an ellipsoid of revolution. J. J. S.

1070. Rectilinear Vortex in a Canal with Plane Parallel Banks. A. Masotti. *Accad. Lincei, Atti,* 12. *pp.* 321–327, *Oct.*, 1930.—In a canal with indefinite plane parallel banks is an indefinite rectilinear vortex parallel to the banks. The motion of the liquid is plane and is in planes normal to the vortex and to the banks. The irrotational motion induced by the vortex in the liquid and the movement of the vortex itself have been studied by various authors and are treated again in this paper with a view to presenting the results in a form suitable for hydrodynamic and electrostatic application. The hydrodynamic application refers to the current which can establish itself around a thin circular cylinder in a channel with parallel plane sides. The complex potential of such a current is specified; a relation between the geometrical elements of the field of motion and the circulation of the current is established; the dynamical actions exerted by the liquid upon the cylinder and on each of the two banks are determined. The electrostatic application is postponed for a later paper. J. J. S.

1071. Stability of Isolated Vortices. R. Mazet. *Comptes Rendus*, 191. *pp*. 832–834, *Nov*. 10, 1930.—The stability of vortices in a channel of polygonal longitudinal section is discussed mathematically along the lines developed in a previous paper [see Abstract 702 (1931)]. J. S. G. T.

1072. Experimental Treatment of Streaming in Physical and Technical Instruction. B. Eck. *Zeits. f. techn. Physik*, 11. 12. *pp*. 506–511, 1930.—Flow phenomena may be demonstrated by employing an apparatus wherein a stream of water flows with constant velocity along a uniform channel; the disturbances caused by obstacles of different forms may be rendered evident by sprinkling the surface of the water with aluminium powder and projecting the image of the surface by means of the epidiascope. Numerous examples are reproduced and discussed. The value of the method for research purposes is indicated. H. F. G.

1073. Hot-Wire Amplifier Method for Measuring Critical Velocity of Flow Past Aerofoils and Cylinders of Small Section. E. Tyler. *Journ. Sci. Instruments*, 7. *pp*. 349–354, *Nov*., 1930.—By observation of the "Æolian tones" behind models of aerofoil, cylindrical and square section, using a hot wire in conjunction with a valve amplifier, critical values of V_cD/ν have been obtained. The minimum values of V_cD/ν at which turbulence sets in is found to be about 60 at grazing incidence for an aerofoil section, whereas for cylinders and square section cords, V_cD/ν is 48 and 40 respectively. The critical V_cD/ν for an aerofoil section falls from 60 at grazing incidence to about 48 at 12°, and then more rapidly to a value of 24 at 25° [See also Abstract 3622 (1930).] AUTHOR.

1074. Application of the New Methods of the Calculus of Variations to Problems in the Theory of Elasticity. N. M. Basu. *Phil. Mag*. 10. *pp*. 886–896, *Nov*., 1930.—The deflection of a uniformly loaded square membrane is obtained by Ritz's method, and the result is tested by consideration of the associated problem set up by elementary reasoning. The twisting couple of an elastic prism of square section when subjected to torsion about its axis is calculated similarly, and is compared with the St. Venant result. It is shown that the results obtained are correct to a fairly high degree of approximation. For the torsion problem it is necessary to know the torsion function itself and not its conjugate function if the displacement or the state of strain and stress at any point is required. The method given supplies the conjugate function to any desired degree of approximation, but the torsion function cannot be constructed from it, as it does not satisfy the potential equation. R. S. R.

1075. X-Ray Measurements in Elasticity. G. Sachs and J. Weerts. *Zeits. f. Physik*, 64. 5–6. *pp*. 344–358, 1930.—The diffraction pattern obtained by reflecting X-rays from a metal surface on to a photographic plate is applied in a simple arrangement to the investigation of the change of lattice spacing in a strained test-piece. By reflecting the $K\alpha$ radiation of copper from a bent duralumin strip, the transverse contraction is shown to be proportional to the applied stress until flow begins. Poisson's ratio and the elastic limit are measured. J. P. A.

1076. Asymptotic Satellites in Problem of Three Bodies. W. H. Gage. *Roy. Soc. Canada, Trans.* 24. *Sect.* 3. *pp.* 125–134, *May*, 1930.—The three bodies consist of two finite spheres, revolving in ellipses around their centre of gravity, and a third body of infinitesimal mass performing an orbit in the neighbourhood of one of the equilateral triangle points. The name " asymptotic satellite " is given to this body because the initial conditions are so chosen that it approaches the equilibrium point as the time approaches infinity. The solutions of the equations of motion of this satellite are obtained. The plane of its orbit is the same as that of the orbits of the other two bodies. G. C. McV.

1077. Theorems Connected with Fermat's Principle. L. Natanson. *Acad. Polonaise Sci. et Lettres, Bull.* 8 *A. pp.* 421–431, *Oct.*, 1930.—A number of mathematical theorems are derived related to Fermat's principle and the Maupertuis principle of least action. An analogy between the equations of equilibrium of a stretched cord subjected to the action of continuously applied forces, and the equations of motion of a material point, suggests an interpretation of the motion of the latter as the equilibrium position of a trajectory to the adjacent elements of which are applied the forces which act on the particle in successive instants. This analogy is established quantitatively. W. S. S.

1078. Friction of Dry Solids in Vacuum. P. E. Shaw and E. W. L. Leavey. *Phil. Mag.* 10. *pp.* 809–822, *Nov.*, 1930.—Friction is performed in a vacuum chamber surrounded by a heating coil, so that the materials—aluminium, silver, copper, nickel, iron and soda-glass—can be heated to 350° C., and exhausted. Every combination of the materials, like and unlike, is investigated. The tilt method of measuring friction is adopted. After repeated heating and cooling it is found that the friction rises and finally settles to values which are practically constant between 15° and 350° C. The coefficient of friction is much higher, especially for light loads, than when the materials are treated in open air. The result of the heat treatment is that friction is increased by increase of softness and increase of affinity. The term " coefficient of friction " requires to be defined in terms of the history and physical condition of the reacting surfaces.
H. H. Ho.

1079. Crystal Structure of Uranium. J. C. McLennan and R. W. McKay. *Roy. Soc. Canada, Trans.* 24. *Sect.* 3. *pp.* 1–2, *May*, 1930.—X-Ray analysis by the Hull powder method indicates that uranium has a body-centred, cubic space lattice with the side of the unit cell equal to 343 × 10^{-8} cm. The density calculated from the X-ray data is 19·6, which is rather higher than the value usually given. A. J. M.

1080. Crystal Structure of Lanthanum. J. C. McLennan and R. W. McKay. *Roy. Soc. Canada, Trans.* 24. *Sect.* 3. *pp.* 33–35, *May*, 1930.—By the powder method it has been found that metallic lanthanum crystallises in the hexagonal system. The coordinates of the atoms referred to hexagonal axes are 1/3, 2/3, 1/4, and 2/3, 1/3, 3/4. The side of the unit cell is equal to 3·72 Å., and the axial ratio is 1·63. This arrangement is the same as that of the hexagonal close packing of spheres. AUTHORS.

1081. Crystalline Structure of the Inert Gases. Examination of Krypton. A. Nasini and G. Natta. *Accad. Lincei, Atti*, 12. *pp.* 141–147, *Aug.*, 1930.—Solid krypton was examined by means of X-rays by the powder method in a special chamber with an internal volume as small as possible on account of the small quantity of the gas available. An atmosphere of krypton was maintained in the chamber. Krypton was found to present a cubic structure with centred faces. The cell containing four atoms has a side of 5·78 Å. and a volume of 193 × 10^{-24} c.c The resulting density is 2·83. Various relations existing between the atomic magnitudes of the rare gases and those of ions and molecules similar to them are discussed. J. J. S.

1082. Crystal Structure of Para-Hydrogen at Liquid-Helium Temperatures. W. H. Keesom, J. de Smedt and H. H. Mooy. *K. Akad. Amsterdam, Proc.* 33. 8. *pp.* 814–819, 1930. *In English. Communication No.* 209*d from the Phys. Lab., Leiden.*—The apparatus used was described in the authors' report on the crystal structure of neon [see Abstract 2402 (1930)]. Explains the method used in calibrating the camera, by making exposures of CO_2 at the temperature of liquid air and of CO at the temperature of liquid hydrogen, and calculating from the known crystal structures the necessary corrections for each case. The density of solid hydrogen at 14° K. is given by K. Onnes and Crommelin as 0·0808, another value calculated is 0·0788. It was not possible to find a simple cubic structure giving a density of about 0·08, and explaining the observed spacings. A hexagonal close-packed structure, with $a = 3\cdot75$ Å. and $c/a = 1\cdot633$, was found to give good agreement between observed and calculated spacings. With two molecules in the unit cell this gives a density, in the neighbourhood of 2° K., of 0·088, which seems not improbable. H. N. A.

1083. Representation of Crystal Structure by Fourier Series. W. L. Bragg and J. West. *Phil. Mag.* 10. *pp.* 823–841, *Nov.*, 1930.—The paper deals with a special aspect of the method of X-ray analysis described in an earlier communication [see Abstract 2921 (1929)]. By using a Fourier series with two variables a projection is obtained, and the question is to what degree such a representation is a faithful image of the crystal structure. The authors use the word "image" advisedly, for the results are shown to possess effects closely analogous to (and in some respects identical with) resolving power and numerical aperture in a microscope. The latter quantity is defined for X-rays as $2 \sin \theta_0$, where θ_0 is connected with the shortest distance d_0 between reflecting planes and the wave-length λ by the equation $d_0 = \lambda/2 \sin \theta_0$. In general, if the coefficients of the Fourier series are still large when the series is terminated, then the "image" has defects akin to those produced by optical diffraction. Introduction of a temperature factor to allow for thermal agitation leads to smaller values of the coefficients, and it appears that under these conditions sharper demarcation between atoms occurs, since the overlapping due to thermal agitation is more than compensated by the obliteration of the diffraction effects. F. I. G. R.

1084. Selection Rules, Generating Operations and Conjugate Point-Manifolds of Crystal Structures. E. Brandenberger. *Zeits. f. Krist.* 76. 1–2. *pp.* 1–86, *Nov.*, 1930.—A purely formal treatment of the symmetry relations indicated by the title. The paper contains matter of importance for the discussion of spatial arrays from topological aspects.
F. I. G. R.

1085. Habit Variation in Crystals of Barium and Lead Nitrates. H. E. Buckley. *Zeits. f. Krist.* 76. 1–2. *pp.* 147–168, *Nov.*, 1930. *In English.*—The method of investigation was that previously described [see Abstract 3017 (1930)]. Ordinarily barium nitrate shows {111} almost exclusively, but when evaporation is extremely slow {100} predominates; a trace of carbonate has a similar effect. Lead nitrate behaves similarly, but changes its habit more readily. The fact that while crystallographic observations indicate tetartohedral (tesseral polar) symmetry X-ray investigation shows paramorphic hemihedral (tesseral central) is discussed, and it is suggested that the latter deduction is due to the inability of the X-ray method to trace a minute parameter in the nitrate ion. The effect of minute additions of numerous substances on the habit is described, and an attempt made to classify the results according as (i) certain planes absorb preferentially, and so, being checked in their growth, become relatively larger; (ii) the growth of certain planes is accelerated, thus causing them to tend to disappear; (iii) planes associated about a certain axis or face normal of the crystal are affected together. C. A. S.

1086. Artificial Etch Figures of α-Sulphur. J. Novák. *Zeits. f. Krist.* 76. 1–2. *pp.* 169–173, *Nov.*, 1930.—Description of experiments upon sulphur from Girgenti with the following etching reagents: carbon disulphide, ethyl ether, aniline, nitric acid and toluol. These compounds yielded holohedral figures, except the first two, which gave rhomboidal forms. F. I. G. R.

1087. Mosaic Structure of Crystals. F. Zwicky. *Helv. Phys. Acta,* 4. 1. *pp.* 49–58, 1931. *In German.*—In general, two effects are discussed which, in an earlier communication [see Abstract 3014 (1930)], were neglected. Recalculation shows that the (001) plane for rock-salt cannot be a true " secondary plane." On the other hand, a gain of energy is found for the contraction of these planes for PbS and PbTe. A table is given in which the directions of the glide planes actually observed can be compared with the values of the energy constants characteristic of a number of binary compounds. Three well-defined groups appear, into which the substances in question fall very clearly, with the exception of MgO, for the failure of which reasons based upon the Boltzmann energy distribution are advanced. The paper concludes with a number of suggestions relating to the appearance of atomic, "layer," and molecular lattices in nature. F. I. G. R.

1088. Element of Atomic Number 61. L. Rolla. *Accad. Lincei, Atti,* 12. *pp.* 270–272, *Oct.*, 1930.—Describes the processes carried out in Florence for the concentration and isolation of the element illinium of atomic number 61. The work is to be extended with new and improved plant. A. D.

1089. Basis of Atomic Weights. A. v. Grosse. *Zeits. f. phys. Chem.* 10. *Abt. B.* 4–5. *pp.* 395–396, *Nov.*, 1930.—Suggests $He^4 = 4 \cdot 0000$ as the basis of atomic weights, and compares it with the reference values $O = 16$, $O^{16} = 16$ and $H = 1$. A comparison table is given of the atomic weights of some of the elements estimated according to the above values. R. C. F.

1090. Atomic Dimensions and the Quantum Theories. K. C. Mazumder. *Zeits. f. Physik,* 66. 1–2. *pp.* 119–121, 1930.—Calculates the mean distance of the electric charge of the atom from the valency electron by means of the old and the new quantum theory. Different methods of calculation are used, and the results of these are tabulated. Those obtained by using $\bar{n}^2 = n^2 + n^2_{\text{eff.}}$ instead of the square of the quantum number n of the valency electron and $\overline{Z} = (Z_{\text{eff.}} + 1)/2$ instead of Z in the equations

are plotted for a number of elements from H to Ba; the graph shows that these "atomic radii" show a distinct periodicity, with well-developed maxima for the alkali metals. The values are due to two components, one of which is periodic, and the other proportional to the atomic number.
H. N. A.

1091. Arrangement of the Electrons in the Commoner Organic Compounds. M. Dunkel. *Zeits. f. phys. Chem.* 10. *Abt. B.* 6. *pp.* 434–458, *Nov.*, 1930.—The results of recent work on the molecular structure of simple compounds are applied in an attempt to forecast the structures of more complicated organic molecules, the polarisability of atoms and their space arrangement in the molecule being brought into relationship with the electronic structure [see Abstract 3027 (1930)]. The most probable electron arrangements for organic compounds of the commoner types are suggested, and the mutual influence of several linkings is investigated approximately. The phenomena of the semi-polar linking and of cumulated and conjugated double linkings are in agreement with experimental results. The structures of benzene and cyclo-octatetraene are discussed. T. H. P.

1092. Chart of Consecutive Sets of Electronic Orbits within Atoms of Chemical Elements. V. Karapetoff. *Frank. Inst., J.* 210. *pp.* 609–624, *Nov.*, 1930.—The chart which is drawn up on rather different lines from previous similar charts gives the most recent results on the allocation of electrons to orbits in the different chemical atoms. All the known chemical elements are included, and, in addition, a hypothetical extrapolation up to an atomic number of 124 is added. The extrapolation is made possible by an empirical rule (the *n*-plus-*k* rule) governing the order in which different kinds of orbits make their appearance in passing from low to high atomic numbers. The rule predicts correctly for all known elements and, together with Pauli's principle, it fixes the electron distribution for elements of atomic number greater than 92 (Uranium), although it is not necessarily suggested that such elements exist. Valency data are also included in the chart and show certain interesting relations.
W. S. S.

1093. Distribution of Electrons in the Atom. L. Goldstein. *Comptes Rendus*, 191. *pp.* 766–768, *Nov.* 3, 1930.—Starting from the equation $\frac{p^2}{2m} - \frac{4e^2}{\pi h}p = e\mathrm{V}$ of Dirac, which gives the relation between the orbital moment p and the atomic potential V, the author arrives at an approximate equation the first term of which gives the electrical interaction between the electrons themselves and the nucleus, the Thomas-Fermi potential, and the second represents roughly the effect of the exchange of the electrons. The potential due to the electrical interaction is diminished as compared with Dirac's original equation. As regards molecular fields, a suitable modification of the Fock-Dirac method would probably make it possible to establish the statistical theory of the homopolar bond, which is not explained by statistics based solely on the electrical interaction of the corpuscles. H. N. A.

1094. Quantised Rotation of Atoms. E. Loedel-Palumbo. *Phys. Zeits.* 31. *pp.* 926–929, *Nov.* 1, 1930.—Criticising the hypothesis of a quantised rotation of certain atoms (mercury, thallium, potassium) put forward by Loyarte [see following Abstract], the author shows that the agreement between computed and observed critical potentials and optical wave-lengths, is entirely fortuitous. It is shown that equally good agreement is obtainable if, in the case of mercury, some other purely arbitrary "rotational quantum," say 1 volt, is chosen instead of Loyarte's 1·4 volts. It is concluded that no physical significance attaches to the numerical relations observed by Loyarte in any of the cases concerned, mercury, thallium or potassium. W. S. S.

1095. Existence of the Additive and Subtractive Potential of 1·4 Volts in the Mercury Atom. R. G. Loyarte. *Phys. Zeits.* 31. *pp.* 929–939, *Nov.* 1, 1930.—The experimental evidence for the existence of a quantised rotation of the mercury atom of amount 1·4 volts is reviewed. It is concluded that all the observed critical potentials of unknown origin can be generated by adding or subtracting 1·4 volts, or a simple multiple of this quantity, from the critical potentials computed from the optical levels. It is also shown that a large number of observed spectral lines correspond to series transitions combined with a change of rotational energy equal to a simple multiple of 1·4 volts. W. S. S.

1096. Correlation of Atomic J Values and Molecular Quantum Numbers, with Applications to Halogen, Alkaline Earth Hydride, and Alkali Molecules. R. S. Mulliken. *Phys. Rev.* 36. *pp.* 1440–1450, *Nov.* 1, 1930.—Rules are given for determining the Ω values and symmetry properties of the molecular states obtainable from the union of two atoms with specified J values, assuming case *c* coupling in the molecule. These are used to determine the correlation of molecular Λ and S values with atomic J values for cases where there is strong L, S coupling in one or both atoms. The correlation rules are applied to I + I, Hg + H, and Cs + Cs. The difficulties which exist when a similar correlation is attempted in cases where the L, S coupling is weak (*e.g.*, Mg + H, or Na + Na) are discussed. The electron configurations and dissociation products are discussed in some detail in the case of the halogen molecules, and an interpretation is given, in terms of electron configurations, of the analogies and differences between the spectra of the members of homologous series of molecules such as F_2, Cl_2, Br_2, I_2, or Li_2, Na_2, K_2, . . . AUTHOR.

1097. Calculation of the Inter-Affinity of the Hydrogen Atom and the Electron. P. Starodubrowsky. *Zeits. f. Physik*, 65. 11–12. *pp.* 806–813, 1930.—The author's expression for the inter-affinity of the hydrogen atom and the electron, developed so far as the fourth power of a constant, *k*, is shown to lead to the value 16·40 ± 0·03 k.cal./mol, and to afford a better value than that obtained by the development of the expression due to Hylleraas, to the sixth power [see Abstract 42 (1931)]. J. S. G. T.

1098. Formation of Beams in Molecular Flow. P. Clausing. *Zeits. f. Physik*, 66. 7–8. *pp.* 471–476, 1930.—Gives formulæ for the distribution in space of molecules which flow through a short tube into an empty vessel. Assuming diffuse scattering on the wall of the tube and a mean free path which is large as compared with the dimensions of the tube, the calculations give large deviations from a beam formed according to the cosine law, even in the case in which the length of the tube is equal to its diameter. Mayer's experiments, however, do not agree with this result. H. N. A.

1099. Mechanical Conception of the de Broglie Wave Theory. A. Korn. *Phys. Zeits.* 31. *pp.* 955–957; *Disc.*, 957, *Nov.* 1, 1930. *Paper read before the Deut. Physikertag., Königsberg, Sept.*, 1930.—Shows, by means of a brief mathematical examination, that instead of the de Broglie wave mechanics contradicting all mechanical observations, it is actually a strong argument in favour of the mechanical theories. An extended equation of state for gases is also developed which explains photoelectric phenomena, and from which Richardson's formula for electronic emission from heated kathodes can also be derived. [See also Abstract 3488 (1929).] R. C. F.

1100. Schrödinger's Theory. J. Delsarte. *J. de Physique et le Radium*, 1. *pp.* 141–152, *April*, 1930.—Schrödinger's wave equation is approached by considering generally the propagation of elastic deformations in the configuration space. This leads to three possibilities, longitudinal waves, transverse waves and mixed waves, for which three distinct wave equations are obtained. The eigenvalues for these three equations are obtained for the free rotator, the harmonic oscillator and the hydrogen atom. In general the eigenvalues of the equation for mixed waves correspond to Schrödinger's eigenvalues. The density of the energy of elastic deformation in the configuration space is found to correspond to the electric charge in Schrödinger's theory. W. S. S.

1101. Acoustical Interpretation of the Schrödinger Wave Equation. R. B. Lindsay. *Phil. Mag.* 10. *pp.* 863–872, *Nov.*, 1930.—One-dimensional compressional vibrations of an ideal fluid of variable density in an infinite tube of variable cross-section are investigated. Non-homogeneity of the fluid is so chosen that the wave velocity is everywhere the same. The problem of determining the stationary wave pattern is formally equivalent to that of solving a Schrödinger one-dimensional wave equation subject to the usual boundary condition. The method is applied to investigate the motion of the free particle, the simple harmonic oscillator and the one-dimensional hydrogen atom. G. E. A.

1102. Aperiodic Processes in Quantum Mechanics. G. Wentzel. *Phys. Zeits.* 31. *pp.* 1006–1011, *Nov.* 15, 1930. *Paper read before the Deut. Physikertag., Königsberg., Sept.*, 1930.—The literature of aperiodic quantum processes is briefly reviewed, including atomic scattering of α-rays, the motion of a hydrogen atom in a homogeneous electric field discussed by Oppenheimer, the Auger effect, and the Dirac and Heisenberg wave mechanics. J. S. G. T.

1103. Perturbation Problems in Quantum Mechanics. J. E. Lennard-Jones. *Roy. Soc., Proc.* 129. *pp.* 598–615, *Nov.* 3, 1930.—Considers an improvement in the perturbation theory by means of a slight modification which overcomes the difficulties in the usual method, in which it is easy to calculate the first approximation of the energy of a system subject to a small perturbation, but difficult to proceed further. The old method expresses the perturbed eigenfunctions in terms of all the unperturbed eigenfunctions of the system, and these are not always known. By the author's method the energy and eigenfunctions of a perturbed system can be calculated to higher approximations with comparative ease. The method is applied to calculate the van der Waals fields of two hydrogen atoms at large distances. The numerical result obtained is the same as the final result of Eisenschitz and London; but the latter involves a series of slow convergence, which can only be evaluated with great labour, while the calculation by the author's method is much easier. It is possible to extend the theory to calculate the van der Waals fields of more complicated atoms. An alternative method is also given by means of which certain problems can be solved, however strong the perturbation. A solution by this method is given of the problem of rotating polar molecules under the influence of an external field, which is a necessary step in the theory of gaseous dielectrics. H. N. A.

1104. Motion under No Forces in Relativistic Quantum Mechanics. E. Schrödinger. *Preuss. Akad. Wiss. Berlin, Ber.* 24. *pp.* 418–428, 1930.—The operator method is applied to Dirac's wave equations of the electron for the no field case. The operator corresponding to the velocity of the electron has two eigenvalues only, $\pm c$. The probable value will be less than c, but it might be expected to have the same order of magnitude. Actually, of course, quite small electron velocities are met with. The apparent difficulty is removed by admitting that the velocity is not rectilinear. The motion is analysed further and shown to be the superposition of a translational velocity corresponding to the momentum of the electron (a constant of the motion), and a periodic vibration which is identified with the spin. W. S. S.

1105. Equations of the Theory of Electrons and Dirac's Wave Mechanics. N. R. Sen. *Zeits. f. Physik*, 66. 1–2. *pp.* 122–128, 1930.—Deduces the impulse and energy equation for the motion of an electron, with the relativity correction, from Dirac's wave equations. The expression for the Lorentz force is also obtained. The results are independent of any special forms whatever of the Dirac matrices, α_1, α_2, α_3 and α_4, as long as these are self-adjoint (*selbstadjungiert*) or Hermitian. H. N. A.

1106. Dirac's Theory of Protons and Electrons. G. I. Pokrowski. *Zeits. f. Physik*, 66. 1–2. *pp.* 129–136, 1930.—Some difficulties in Dirac's theory [see Abstract 2416 (1930)] are pointed out, and it is shown that the following consequences must follow from it. There exists an upper limit for the frequency of every radiation. A radiation with greater frequency cannot propagate itself in space with macroscopic extent. Every motion of an elementary particle takes place by jumps in which the shortest time between two consecutive jumps cannot be smaller than a determined value. From considerations in agreement with the picture of Dirac it may be deduced that the gravitation potential cannot exceed a determined value. Between atom abundance and mass defect there exists a simple connection which is confirmed experimentally and partly quantitatively. Most of these views have been previously deduced by the author in another way. J. J. S.

1107. Dirac's Equation. F. J. v. Wisniewski. *Zeits. f. Physik*, 66. 9–10. *pp.* 697–703, 1930.—It was shown previously [see Abstract 48 (1931)] that Maxwell's equations could be developed from Dirac's wave equation for the electron if certain further relations between the wave functions were assumed. It is now shown that Maxwell's equations can be derived from the Dirac equation alone, if Dirac's expressions for the electric charge and current density are suitably modified and the existence of magnetic charges and currents are admitted. W. S. S.

1108. Possibility of Avoiding an Infinite Auto-Reaction for the Electron. W. Anderson. *Zeits. f. Physik*, 66. 9–10. *pp.* 712–720, 1930. —In a recent article [see Abstract 369 (1931)] V. Ambarzumian and D.

Iwanenko put forward the theory of a lattice-formed structure of space, the relative distance of two elementary electrical particles being never less than $a = 6 \cdot 34\, e^2/m_0c^2$, and in this way avoid an infinite auto-reaction for the electron. The author of the present paper had previously put forward the theory of a compressible elementary electrical particle, according to which, when a "gas" is formed of such particles, the average distance between two neighbouring particles can never be less than a, where a must satisfy the condition $10 \cdot 6e^2/c^2m_0 > a > 4 \cdot 42e^2/c^2m_0$. The author is unable to explain why his theory and that of Ambarzumian and Iwanenko lead to such similar results, though they depend on such different viewpoints. H. N. A.

1109. Secondary Evidence Relating to the Theory of Relativity. G. v. Gleich. *Zeits. f. Physik*, 65. 11–12. *pp.* 848–858, 1930.—The author considers that observations of the deflection of light as measured by the American observers at the eclipse of Sept. 21, 1922, considered numerically, do not support the theory of relativity. The deflection of light and displacement of spectral lines towards the red can be mutually correlated without appeal to the theory of relativity. J. S. G. T.

1110. Unified Field Theory. Part I. T. Y. Thomas. *Nat. Acad. Sci., Proc.* 16. *pp.* 761–776, *Nov.*, 1930.—A new treatment of Einstein's unified field theory of parallelism at a distance. The author shows how to get the explicit values of the Riemannian coordinates, x^i, in terms of the "local" coordinates, z^i, which are defined by Einstein's four unit orthogonal vectors at each point of the space. The solution depends on the postulate that the paths of the space passing through any point are straight lines, in terms of the set of local coordinates z^i, whose origin is at the point considered. It is then shown that the components of a tensor referred to the z^i coordinates form a set of absolute invariants at each point, in the sense that they are invariant under any analytic transformation of the Riemannian coordinates x^i. A set of field equations is then proposed which are 16 equations of wave motion (referred to z^i coordinates) determining the 16 quantities h^i_a of Einstein's theory, *viz.*, the 16 components, referred to the Riemannian coordinates, of the four unit orthogonal vectors at each point of space. Four of the h^i_a are identified with the electromagnetic potential vector. Then it is shown that the field equations involving these reduce to Maxwell's equations, referred to the local coordinates z^i. The remaining equations can be reduced to a form analogous to the gravitational equations of the older relativity theory. In a footnote, the author points out the difference between Einstein's, Levi-Civita's and his own treatment of the unified field theory. G. C. McV.

1111. Einstein's Theory of Distant Parallelism. R. Zaycoff. *Zeits. f. Physik*, 66. 7–8. *pp.* 572–576, 1930.—In continuation of previous work [see Abstract 934 (1930)], the author discusses a modification of the theory of distant parallelism which enables the equations of the theory to be expressed in symmetric form, and which conforms with recent developments in theoretical physics. J. S. G. T.

1112. Gravitational Action of Light. L. Rosenfeld. *Zeits. f. Physik*, 65. 9–10. *pp.* 589–599, 1930.—The gravitational field generated by an electromagnetic field in the absence of matter is derived using quantum mechanics. It appears that the gravitational energy comes out to be infinite, a result representing a new difficulty for Heisenberg and Pauli's theory of quantisation of wave fields. The analysis leads to a description of the possible interchange processes between light quants and "gravitational quants." W. S. S.

1113. Velocity of Propagation of Newtonian Attraction. J. Chazy. *Comptes Rendus,* 191. *pp.* 761–763, *Nov.* 3, 1930.—Considers the hypothesis of Laplace for the movement of planets round the sun, in which it is supposed that gravitation is produced by the impulsion of a fluid which is propagated from the planet to the sun, and the hypothesis of Lehmann-Filhès for the motion of translation of the solar system towards its apex. Shows that applied to the same movement these two hypotheses lead to effects of the first order which have the same absolute value, but are in opposite directions. Applies the two hypotheses to the rotational motion of the sun. The final conclusion is that the inferior limit for the velocity of propagation of the attraction given astronomically is of a different order of magnitude from that which seems to be given by laboratory experiments. H. N. A.

1114. Kepler Problem in Five-Dimensional Wave Mechanics, and the Effect of Gravity upon the Balmer Formula. N. R. Sen. *Zeits. f. Physik,* 66. 9–10. *pp.* 686–692, 1930.—A discussion of the Keplerian problem of central attraction, based on Klein's five-dimensional wave equation [see Abstract 2541 (1926)] is presented. The analysis shows that while the continuous spectrum exists for positive energy values, the discontinuous spectrum corresponding to discrete negative values of the energy, *i.e.*, the Balmer series, is not, in general, present. The anticipated displacement of spectrum lines towards the red end of the spectrum, due to a gravitational field, is not established by the analysis. J. S. G. T.

1115. Relativistic Wave-Mechanics Motion of Material Particles in a Homogeneous Gravitational Field. N. R. Sen. *Zeits. f. Physik,* 66. 9–10. *pp.* 693–696, 1930.—The motion of a material particle in a homogeneous gravitational field in accordance with the principles of relativistic wave mechanics, is discussed. A relation between U, the velocity of the particle, and E, its energy, is derived in the form $1/U = \{1 + (3a^2 - 2)gx/c^2(1 - a^2)\}/(c\sqrt{1 - a^2})$, in which $a = m_0c^2/E$. If $E = \epsilon + m_0c^2 (\epsilon < m_0c^2)$, then $M_0U^2\{1 + 3\epsilon/2m_0c^2\}/2 = \epsilon[1 - (3gx/4c^2) + (m_0gx/2\epsilon)]^{-2}$. In the case of weak gravitational fields and large velocities the equation corresponds with the energy equation of classical dynamics, the velocity of the particle in the latter theory being identified with the group velocity of the phase waves. J. S. G. T.

1116. Relation between Einstein's Formula for the Mass of the Universe and One Deduced in an Independent Way by the Author. W. Anderson. *Zeits. f. Physik,* 66. 11–12. *pp.* 858–859, 1930.—Einstein has given the formula $M = 4\pi^2R/\kappa$ for the mass M of the universe, where R is the radius of curvature of space, and κ is $8\pi K/c^2$, K being the ordinary gravitation constant. This gives $M = 0{\cdot}44c^3/\sqrt{\rho K^3}$, where ρ is the mean density. The author, in quite an elementary manner, using the special and not the general theory of relativity, and regarding space as Euclidean, has arrived at the formula $M = 0{\cdot}37c^3/\sqrt{\rho K^3}$, which is the same as that of Einstein except for a somewhat smaller numerical factor. H. N. A.

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METEOROLOGY, GEOPHYSICS, AND ASTROPHYSICS.

1117. Amount of Ozone in the Earth's Atmosphere and Its Relation to Other Geophysical Conditions. G. M. B. Dobson. With Reports by H. H. Kimball and E. Kidson. *Roy. Soc., Proc.* 129. *pp.* 411–433, *Nov.* 3, 1930.—To show the main features of the annual distribution of O_3, one year's observations were obtained at five widely scattered stations, Arosa, California, Helwan, Kodaikanal and Christchurch (New Zealand). Tables and diagrams illustrate the results. For winter in high latitudes the data are scanty. The Indian values are unaffected by the onset of the monsoon and in this respect differ from those in temperate latitudes. In Egypt and New Zealand the same relationship holds as in Europe. **Kimball** found small departures from mean values in California, but the increase is associated with a flow of cold air. **Kidson,** in considering the normal pressure changes at the surface and above in New Zealand, finds the results in agreement with those elsewhere regarding the relative amounts of O_3 in correlation with pressure and temperature. The author, in conclusion, considers the series of results, and supports Lindemann's hypothesis that changes in the upper air temperature following changes in the O_3 content may be the cause of pressure variations at the earth's surface. A *résumé* of the results obtained is given, the chief O_3 forming and destroying agents and their effects are considered, and the connection between O_3 high in the atmosphere and the meteorological conditions lower down is discussed. For further research a new type of photoelectric spectrophotometer is being tested. [See also Abstract 2120 (1929).]

R. S. R.

1118. New Method for Estimating Atmospheric Ozone. A. I. Duninowski. *Comptes Rendus,* 191. *pp.* 859–861, *Nov.* 10, 1930.—Energy/wave-length curves for the solar spectrum for the interval 4860–1200 Å. are obtained by focussing a narrow portion of the spectrum on a thermo-element and recording the resulting current photographically. A series of such curves for varying thicknesses of air traversed enable the value of Δ in the relation $I = I_0 \times 10^{-m\Delta}$($m$ = mass of air traversed) to be determined. The equivalent thickness of ozone at N.T.P. can then be deduced by the method of Cabannes and Dufay [see Abstract 70 (1927)] without the special arrangements required for observations with ultraviolet light. The equivalent thickness of ozone at Montpelier during the autumn of 1929 was in this way found to vary between 0·20 and 0·36 cm.

C. A. S.

1119. Relation between Temperature and Pressure in the Troposphere. C. K. M. Douglas. *Roy. Meteorolog. Soc., Mem.* 3. *pp.* 159–168, *Nov.,* 1930.—It is shown that the high correlation coefficients of pressure and temperature high up in the troposphere occur where pressure is closely related to the mean temperature of the air column below. This indicates a tendency for a constant temperature lapse rate. The following factors may affect it and are considered: (1) radiation; (2) eddy diffusion, or small scale turbulence; (3) vertical motion over areas comparable with depressions or anticyclones; and (4) air of the same origin at all levels in the troposphere, and no marked subsidence in it. Groups, of extreme cases, show that when the barometer at sea-level is very low or very high, the troposphere contributes about half of the deviation from the mean. Both cyclones and anticyclones can be grouped into systems largely confined to the troposphere and systems extending to the stratosphere. The argument in favour of an advectional theory is developed. [See Abstracts 33 (1920), 292 (1923) and 3279 (1929).] R. S. R.

1120. Humming of Aerial Lines and Atmospheric Disturbances. A. Nodon. *Comptes Rendus*, 191. *pp.* 959–961, *Nov.* 17, 1930.—Humming in an ordinary aerial telegraph line begins some twenty hours before the arrival of a disturbance from a direction perpendicular to the line. To use this method of forecasting, two such lines are to be erected running north and south, and east and west, respectively, provided with microphones at one end, whence the vibrations are transmitted to amplifiers It is proposed to use such an arrangement at the Biarritz observatory to forecast the *galernes*, sudden westerly storms, which spring up with little warning. The humming is attributed to the electrostatic attraction of rapidly moving small masses of charged air. C. A. S.

1121. Radiation Measurements on the Stolz Alps from Nov. 1, 1928, to Oct., 1929. R. Holzapfel. *Akad. Wiss. Wien, Ber.* 139. 2*a*. 7–8. *pp.* 373–392, 1930.—Measurements were made at a height of 1200 m. of the total thermal radiation by means of a Michelson bimetallic actinometer and also through red and yellow filters. Mean monthly values are calculated for each hour from 7 a.m. to 5 p.m. for the total intensity and certain spectral regions. By combination with the corresponding zenithal distances of the sun, the total heat received on a unit horizontal surface is found for a cloudless day. These results are compared with those for Kolberg, Potsdam, Vienna, Davos, Arosa and Agra, and show the favourable situation on the Stolz Alps. Using an Elster-Geitel-Dorno photoactinometer, the ultra-violet intensity of solar radiation is found and monthly means are tabulated. R. S. R.

1122. Graphic Constructions for Artificially Produced Seismic Waves. E. A. Ansel. *Gerlands Beitr. z. Geophys. Angew. Geophys.* 1. 2. *pp.* 117–136, 1930.—The path-time curves and wave-front movements of seismic waves resulting from detonations at a given point or points are discussed as regards the effect of strata in which propagation is at differing speeds. It is shown how the depth, thickness, dip and strike of, and faults in, such strata may be deduced. Graphic constructions are given for the cases of (1) a stratum lying parallel to the surface, (2) a change in direction of a stratum, (3) two strata of varying thicknesses, and (4) a fault. The method is also applied to the detection of a salt-dome, and constructions given for the determination of the depth and flank slope, and of the depth to which the latter can be inferred. The case of a dome made up of several different strata is also dealt with. The maximum depth at which detection is possible is discussed, and it is shown what may be expected for a dome of 2 km. deep with a detonation 9 km. distant. The best positions for observing instruments and the effects of variations in the strata, and of indefiniteness in the boundaries thereof are discussed. C. A. S.

1123. Position of the Epicentres of Earthquakes. B. Berloty. *Comptes Rendus*, 191. *pp.* 813–816, *Nov.* 10, 1930.—Calculation shows that for an ellipsoid such as the earth, the line of maximum deformation under the action of the moon's attraction corresponds to latitude 35° 15′ 52″.

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It is shown that the number of epicentres of earthquakes is a maximum in latitude 35° 15′ 36″. C. A. S.

1124. Electro-Geophysical Field Measurements with L.F. Alternating Current. T. Diekmann. *Gerlands Beitr. z. Geophys., Angew. Geophys.* 1. 3. *pp.* 255–285, 1931.—Quantitative measurements of the distribution of magnetic field intensity were made in a region of much folded Devonian schist. The horizontal components of magnetic intensity parallel and perpendicular to the line joining the electrodes and the vertical component were measured, and from these the magnitude and direction of the resulting vector were found. For the line bisecting and perpendicular to that joining the electrodes diagrams show the distribution of the components and the angle the horizontal component makes with the strike of the geological beds. The distribution of the field intensity is shown for various positions of the electrodes in the region examined. The fundamental magnetic field is obtained as based on topography. Diagrams show the deformation produced by the geological structure of the region investigated. R. S. R.

1125. Swedish Geoelectrical Methods. K. Sundberg. *Gerlands Beitr. z. Geophys., Angew. Geophys.* 1. 3. *pp.* 298–361, 1931. *In English.*—This paper describes the theoretical principles upon which the Swedish geoelectrical methods are based and gives a summary of the most important practical results. After a short account of the history of geophysical prospecting follows a theoretical treatment of the electrical properties of the earth's crust, showing that content and composition of impregnated waters determine the electrical conductivity of rocks. The geoelectrical methods are classified as potential, electromagnetic and inductive methods, and the theory of each group of methods is treated. The importance of Kelvin's theory of images for the comprehension of the potential methods is emphasised by several examples. The following two cases referring to inductive methods are fully treated mathematically: (1) Cylindrical conductor in homogeneous field, the axis of the cylinder paralleling the field. (2) Horizontal layers with infinite horizontal extension. Electromagnetic methods are a combination of potential and inductive methods, both in principle and theory. Numerous results of small-scale investigations illustrate the theoretical conclusions. The influence of the magnetic properties is briefly treated. The arrangements for the investigation of the electric and magnetic field are described, and, finally, practical results are briefly referred to. AUTHOR.

1126. Law of Solar Rotation. M. Notuki. *Phys. Math. Soc. Japan, Proc.* 12. *pp.* 264–274, *Nov.*, 1930. *In English.*—On the assumption that the rotational angular velocity of a sunspot depends only on the level of the spot, an expression for the angular velocity is deduced and, neglecting the effect of refraction, the probable sidereal rotational angular velocity of the photosphere is derived. The results show that the angular velocity at higher levels is greater than at lower levels and that the equatorial acceleration found for low levels vanishes for the upper levels. Values of the solar rotation derived by Evershed from observations of the H and K lines in prominences are discussed. The author concludes that if the law of solar rotation is to be associated with the flux of radiation from the sun's centre, then the viscosity of the sun must be a maximum at its outer layer. J.S.G.T.

1127. Possible Emission of Electric Currents from the Sun. V. C. A. Ferraro. *Roy. Astron. Soc., M.N.* 91. *pp.* 174–184, *Nov.*, 1930.—Calculations indicate that solar streams of positive ions and electrons towards the earth cannot, by themselves, exert any appreciable magnetic fields that may have a bearing on terrestrial magnetic storms. H. L. B.

1128. Recombination in Ionised Streams of Corpuscles from the Sun. V. C. A. Ferraro. *Roy. Astron. Soc., M.N.* 91. *pp.* 184–187, *Nov.*, 1930.—A calculation is made of the amount of recombination of ions into neutral atoms in an ionised stream of corpuscles during its passage from the sun to the earth. The case of Ca^+ ions is considered in detail. It is shown that, provided the number of initial ions does not exceed 10^9 per c.c. at emission, recombinations of ions into neutral atoms can be neglected. It seems unlikely that streams of corpuscles as dense as these can be emitted from the sun. H. L. B.

1129. Study of the Solar Corona in the Absence of an Eclipse. Lyot and E. Esclangon. *Comptes Rendus*, 191. *pp.* 834–838, *Nov.* 10, 1930.—The solar corona has been investigated and the polarisation of its radiation established and measured at the Pic du Midi in 1930, in the absence of an eclipse. J. S. G. T.

1130. Multiplet Intensities in the Solar Spectrum. R. van der R. Woolley. *Mt. Wilson Observat. Contrib. No.* 413. *Astrophys. J.* 72. *pp.* 256–266, *Nov.*, 1930.—The widths of the lines in a titanium multiplet in the solar spectrum have been measured and compared with the theoretical intensities given by the quantum theory, which are in agreement with the observations of laboratory emission spectra. There is a marked divergence in the solar spectrum, the weaker lines appearing relatively stronger. Further, a survey of all the lines in the solar spectrum in the region $\lambda\lambda$4500–4600 was made. When the lines are grouped together according to Rowland intensity, the square of the mean width, which gives the number of atoms concerned in the formation of the line, shows a similar marked divergence from the values found by Adams and Russell [see Abstract 3196 (1928)], who calibrated the Rowland intensities on the basis of theoretical multiplet intensities. Multiplet intensities in the solar spectrum differ widely from intensities in emission spectra, the weaker lines being relatively stronger in the solar spectrum. AUTHOR.

1131. De Sitter's Universe. G. Castelnuovo. *Accad. Lincei, Atti*, 12. *pp.* 263–269, *Oct.*, 1930.—If de Sitter's theory (1917) of a finite universe were true, the result would be that a distant time-piece would appear to be retarded, and the light from a distant star would appear as if displaced towards the red end of the spectrum, without there necessarily being any recession of the distant star from the earth. In fact, most of the distant stars do show a reddening. The amount of the reddening would enable a conclusion to be reached as to the radius of the finite universe. De Sitter himself calculated the radius. In his recent book on *The Size of the Universe*, L. Silberstein has called attention to de Sitter's hypothesis, and has re-calculated the radius by a statistical method and with more abundant data. The author, however, does not see how Silberstein justifies his correlation between radial velocities and distances, and finds that the statistical method itself raises doubts. He has, therefore, taken up the subject *de novo* and used a new and simpler method, thus finding an approximate formula for the relation between the distance of the star and the radius of curvature. Lastly, he discusses in detail the hypotheses introduced. The observed Doppler effect is the sum of a true Doppler effect corresponding to approach or recession of the star, with a de Sitter effect proportional to the square of the distance of the star. These two cannot be disentangled by observations on a single star; we must have some statistical method of grouping the stars. A. D.

1132. Slow Contraction or Expansion of a Fluid Sphere. L. H. Thomas. *Roy. Astron. Soc., M.N.* 91. *pp.* 122–127, *Nov.*, 1930.—The equilibrium theory of slow contraction or expansion of a fluid sphere is discussed mathematically for the case in which there is no internal generation of energy, and it is shown that the change occurring will not, in general, be to a homologous density distribution even if the sphere be gaseous. Hence Lane's law cannot be expected to hold. In order that homologous contraction should occur it is necessary (1) that there should be a certain relation between the energy U and the opacity K, (2) that the initial distribution of mass and temperature should satisfy an additional differential equation besides that of dynamical equilibrium, and (3) that the state should satisfy a further stability condition as well as those for dynamical and " thermodynamical " stability. J. S. G. T.

1133. Contraction of the Universe. W. H. McCrea and G. C. McVittie. *Roy. Astron. Soc., M.N.* 91. *pp.* 128–133, *Nov.*, 1930.—Following Lemaître's and Eddington's analyses, the authors discuss non-stationary universes in which there is a single condensation of matter at the origin, and show that such a universe would start contracting. Moreover, if the actual universe started as an Einstein universe, and is now expanding, as the work of Lemaître and Eddington suggests, this expansion cannot have been caused by a redistribution of matter into massive nuclei. J. S. G. T.

1134. Resonance Theory of the Origin of the Moon. Part II. H. Jeffreys. *Roy. Astron. Soc., M.N.* 91. *pp.* 169–173, *Nov.*; 1930.—The validity of Darwin's theory that the birth of the moon from the earth was due to the enormous increase of the sun's tidal action on the earth-moon mass by resonance depends on the smallness of the friction involved. Friction necessarily fixes an upper limit to the amplitude of an oscillation attainable by resonance. The author has shown in Part I of this paper [see Abstract 474 (1918)] that the requisite coincidence of periods can be attained only if the earth's lack of homogeneity be taken into account; the central core must be considered. This introduces a possibility of friction in the tidal currents in the outer shell which flow over the central core. The author estimates the friction and finds that it is sufficient to invalidate Darwin's theory. The abandonment of the resonance theory seems to favour the opinion that the moon has been separate from the earth ever since the early catastrophe that formed the planets. There are strong reasons for believing that the original disruptive encounter of the sun and a star was not merely a close approach, but an actual collision. It seems unlikely that the moon will offer any difficulty not presented by any other satellite to this theory. H. L. B.

1135. Orbit of the Trans-Neptunian Planet. M. Pierucci. *Accad. Lincei, Atti,* 12. *pp.* 103–104, *Aug.*, 1930.—Taking into account the latest determination by Crommelin of the elements of Pluto, which is based on the Brussels observation of 1927 and the four photographs taken at

Mt. Wilson in 1919, the table of orbits of the nine great planets agrees even better than before with the theory previously announced [see Abstract 78 (1931)]. The mean error for all the planetary distances is now only 4·31 % instead of 4·33 %. M. A. E.

1136. Visual and Photographic Study of Meteors. E. Öpik. *Harvard Coll. Obs., Bull. No.* 879. *pp.* 5–8, *Nov.* 1, 1930.—The average height at which meteors appear may be assumed equal to a certain constant, and, therefore, the distance of a meteor from the observer depends, on the average, solely on its zenith distance. Those at greater zenith distances are further away, and, therefore, intrinsically more luminous than near meteors, and for a given solid angle they can be observed on a larger area. Tables are given showing the frequency of meteors observable at different zenith distances with the naked eye, with a telescope of 66 mm. aperture, and on a photographic plate. The maximum of apparent frequency occurs at about zenith distance 45° for visual observations, and at 75° for photographic; but, on account of the size of the photographic field, it is advisable to direct the camera to about 60°. The choice of camera and plates is discussed, and it appears that the absolute dimensions of the camera are of no importance if the focal length of the objective exceeds 4 to 8 cm.; for although a large objective will record a greater number of meteors, this gain as compared with the total area of the plate and the total number of meteors will not justify the enormous difference in price. M. A. E.

1137. Faint Meteors Observed in Orbit of Comet Schwassmann-Wachmann, 1930d. K. Nakamura. *Roy. Astron. Soc., M.N.* 91. *pp.* 204–209, *Nov.*, 1930.—A radiant point near ϵ Bootis on May 21 showed many meteors, but these proved not to belong to the comet. On May 24 a radiant point was found from a stationary meteor at $\alpha = 230°$, $\delta = +48°$, and, although this preceded the comet's passage through the descending node, agrees with the calculated orbit and with a similar experience in the case of comet Pons-Winnecke. The observation of both comet and meteors was continued during the following nights, and a map is given of the climax of the shower on June 9, and a table of the radiant points from 1930 May 24 to June 19. The author finds faint meteors unexpectedly numerous in the case of the Winnecke shower; the meteor paths from Schwassmann-Wachmann are short and thick, being somewhat spindle-shaped; the azimuths of meteor streaks are also peculiar, those from Schwassmann-Wachmann making their appearance mostly towards β Draconis and Vega. A. S. D. M.

1138. Early Irregularities in the Use of the Julian Calendar. L. Caldo. *Accad. Lincei, Atti,* 12. *pp.* 104–108, *Aug.*, 1930.—No authentic official document and no contemporary notice concerning Julius Cæsar's reform of the calendar are known to exist, but we depend solely on a few contradictory references written at least a century later. Solinus and Macrobius, living in the fourth and fifth centuries A.D., affirm that after Cæsar's death the Roman priests added an extra day to the year every three years instead of every four, and that the error was corrected by Augustus. On the other hand, Cassius Dio states that in the year 713 U.C. (= 41 B.C.), a day was intercalated in order that the following first day of January should not fall on a fair-day (the nundinæ), which would have been most unlucky, and had always been avoided from ancient times, but that later a day was omitted so that the Julian calendar should not be interfered with. It is an historic fact that in the year 711 the first day of January did fall on the nundinæ, and a table here given shows that the same would have happened in 714, but not again for many years. If we accept the statement of Cassius Dio—and he was an historian, as well as a senator of Rome, and he wrote as early as the second century A.D.—it seems clear that Cæsar ignored the old superstition, but that the priests, not from ignorance, but intentionally intercalated a day after an interval of three years to avoid an unlucky coincidence, without, however, allowing it to disturb the Julian calendar. Our chronologists have not paid sufficient attention to this passage. M. A. E.

1139. Interior of Stars. W. Anderson. *Zeits. f. Physik*, 66. 3–4. *pp.* 280–284, 1930.—The results obtained, for which the paper must be consulted, are based on the work of Stoner and Milne, who find that the interior densities of stars are incomparably greater than the values hitherto accepted. H. H. Ho.

1140. Analysis of Stellar Structure. E. A. Milne. *Roy. Astron. Soc., M.N.* 91. *pp.* 4–55, *Nov.*, 1930.—In contrast to the current theory of the equilibrium of a perfect gas star, the author works out the theory of two star models on the new basis that the mass M, the luminosity L and the opacity K are three independent variables and that the observed correlation of M with L in nature must depend on the physics of the energy-generating process in the star. In the first model there is only one source of energy, at the centre of the star, and the opacity is constant. In the second, the opacity and the rate of generation of energy are both constant. The integration of the equations of the problem is performed from the boundary inwards, the data providing sufficient boundary conditions for this to be possible. In both models, for given M, there are two luminosities, L_1 and L_0, such that for $L>L_1$ there are no equilibrium states; for $L_1>L>L_0$ the states correspond to the giant and ordinary dwarf stars, and for $L_0>L>0$ the states correspond to the white dwarfs. For $L=L_0$ the diffuse perfect gas stars of Eddington's theory are obtained. Excluding this type, the other two are shown to possess cores in which the gas laws do not hold, and in the case of the white dwarfs, where the core forms the major part of the star, the theory of the core as a perfect gas in a "degenerate" state is developed. The theory provides a value for the radius of white dwarfs, but the radius is arbitrary for arbitrary L and M in the other cases. The study, still incomplete, of perfect-gas envelopes surrounding "degenerate" cores suggests that ordinary stars must be of the two types, giant and ordinary dwarf. [See also two following Abstracts.] G. C. McV.

1141. Numerical Integration of Emden's Polytropic Equation Index Three. N. Fairclough. *Roy. Astron. Soc., M.N.* 91. *pp.* 55–63, *Nov.*, 1930.—The equation $\frac{1}{\epsilon^2}\frac{d}{d\epsilon}\left(\epsilon^2\frac{d\theta}{d\epsilon}\right) = -\theta^3$ plays an important rôle in the work of Milne [see preceding Abstract]. Integral curves are given, obtained by numerical integration of the equation with the initial conditions $\epsilon = 1$, $\theta = 0$, $d\theta/d\epsilon =$ a given negative number. Seven different tables are given. G. C. McV.

1142. Emden's and Similar Differential Equations. R. H. Fowler. *Roy. Astron. Soc., M.N,* 91. *pp.* 63–91, *Nov.*, 1930.—A rigorous discussion of the solutions of the equation $\frac{1}{\epsilon^2}\frac{d}{d\epsilon}\left(\epsilon^2\frac{d\theta}{d\epsilon}\right) + \epsilon^{\sigma'}\theta^n = 0$ (σ' constant and $n > 1$), which is a generalisation of the equations of Emden's type which occur in Milne's work [see two preceding Abstracts]. The asymptotic forms of the solutions as $\epsilon \rightarrow 0$ are given and the classes of solutions discussed. For the cases $\sigma' = 0$, $n = 3$ or $n = \frac{3}{2}$, which are those used by Milne, as $\epsilon \rightarrow 0$ all the solutions are ultimately monotonic functions of ϵ and approach either a finite limit or $\pm\infty$. If the integration is performed inwards from some point (ϵ_0, θ_0), the types of solution depend on whether this starting point lies above, below, or on certain critical curve of the form $\theta = \alpha\epsilon^{\omega}$ and on the value of the starting gradient $d\theta/d\epsilon$. The paper is mathematical throughout. G. C. McV.

1143. Point-Source Model of Star. T. G. Cowling. *Roy. Astron. Soc., M.N.* 91. *pp.* 92–108, *Nov.*, 1930.—The model consists of a star of perfect gas of constant opacity and having a single source of energy of known strength situated at the centre of the star. The problem is shown to depend on the solution of a single differential equation of the third order connecting the temperature with the distance from the centre. This equation not being integrable in terms of known functions, it is treated by discussing the asymptotic forms of the first integrals for large and small values of the independent variable. The various types of solution are thus classified. It is then shown that those models which satisfy boundary conditions consistent with the facts found for actual stars are infinite in size and mass. It can be shown, however, that the density of the gas at a distance from the centre of the order of the radius of actual stars is negligibly small. Thus the star may be said to terminate effectively. For an assigned luminosity the analysis suggests that heavy stars have less mass concentrated at the centre than stars of small mass. No indication is found for a belief that to a given luminosity corresponds a unique mass. G. C. McV.

1144. Opacity of Extended Stellar Envelopes. A. Eddington. *Roy. Astron. Soc., M.N.* 91. *pp.* 109–120, *Nov.*, 1930.—Algol and Capella have nearly the same mass and luminosity, but the radius of Algol is 2 million km. and that of Capella 9½ million. It is inferred that Algol is in a more condensed state and, therefore, a later stage of evolution than Capella. But it is possible that the outer envelope of a star contains so small a fraction of its total mass that a large difference in diameter implies no great difference in potential energy, and has no evolutionary significance. On this view, giantism might be a casual phenomenon, perhaps like Cepheid variability. Extended envelopes play a prominent part in Jeans' liquid star theory and in Milne's new nuclear star theory, since both demand, at least in some cases, a large concentration of mass at the star's centre, and consequently a reduction of density in the outer regions. These two theories, instead of curing the discrepancy between astronomical and physical calculations of the opacity of stellar material, give an even greater discordance than that which forms the outstanding difficulty in the author's own theory. For although the core of high density postulated by both need not have a high opacity, because it is assumed to be liquid, the tenuous envelope which fills up the remaining volume of the star must have a high opacity in order that it may be supported in equilibrium. These theories, therefore, merely transfer the discordance from the core to the envelope, which shows how persistent is the astronomical demand for high opacity. A discussion of the suggestion concerning giant stars shows, however, that this is not acceptable, for if giant stars were essentially similar to main series stars of equal mass, the inflation being limited to their outer layers, the required differences of opacity corresponding to the different extensions are found to be large, and it seems unlikely that the material of the envelopes could be so variable. M. A. E.

1145. Temperature Distribution in the Deep Layers of Stellar Atmospheres. M. Bronstein. *Roy. Astron. Soc., M.N.* 91. *pp.* 133–138, *Nov.*, 1930.—An integral expression for $\lim_{\tau \to \infty} [\phi(\tau) - \tau]$, in which $\phi(\tau)$ represents Hopf's function at an optical depth τ in a stellar atmosphere, is deduced in the form $\lim_{\tau \to \infty} [\phi(\tau) - \tau] = (3/2) \int_0^\infty \mathrm{E}l_2(t)\phi(t)\,dt$, the function E being that occurring in Milne's integral equation. Approximate values of the limit are derived in the form of inequalities. Somewhat similar inequalities derived by Ambarzumian are also given. J. S. G. T.

1146. Theoretical Contours of Absorption Lines. A. Pannekoek. *Roy. Astron. Soc., M.N.* 91. *pp.* 139–169, *Nov.*, 1930.—In papers by various authors the residual intensity of the radiation emitted from the outer layers of stellar atmospheres has been calculated for the case of black absorption as well as for that of diffusion (scattering) and has been found to depend only on the ratio of the diffusion coefficient to the black absorption coefficient. The absolute values of these coefficients do not enter into the formulæ obtained. This ratio is assumed constant for the whole atmosphere. In reality, however, it is not constant, because the absorption coefficients increase with pressure, *i.e.*, with the depth in the atmosphere. To remove doubts that have been expressed about the validity of the calculations hitherto made, the author has worked out exactly the consequences of strictly defined suppositions and compared the theoretical results with those of observation. He obtains a very approximate solution of the equations that represent as nearly as possible conditions such as are supposed to exist in these atmospheres. A general formula is arrived at which shows the following relations: (1) For the same element $\Delta\lambda \sim \sqrt{n}$, where n is proportional to the weight of the transition producing the line. (2) For different elements in the same atmosphere $\Delta\lambda \sim \sqrt{n/\mu}$, where n/μ denotes the relative number of active atoms. (3) For giant stars with low g the lines are wider than for dwarf stars in the inverse ratio $\sqrt[4]{g}$. (4) For hotter stars the lines are wider than for cooler stars in the ratio $T^{3/8}$. Influences other than those contained in the initially defined suppositions are discussed by the author in order to account for discrepancies between theory and observation. Attention is drawn to the importance of taking stellar spectra with instruments of great resolving power as otherwise the observations may be misleading. H. L. B.

1147. Variations of Light of the Variable RZ Cassiopeiæ. A. Fresa. *Accad. Lincei, Atti*, 12. *pp.* 328–334, *Oct.*, 1930.—The results are given of a series of observations of the minimum of the variable at eclipse continued during a month at the observatory of Capodimonte. The observations were made with the equatorial of Fraunhofer of 18 cm. aperture and 3 m. focal distance, with registering photometer with

Töpfer's wedge. A light curve of the variable at eclipse is given, and a table showing the magnitudes of the variable whose values were obtained by means of comparison with two reference stars. The light curve shows that there is a well pronounced secondary minimum in proximity to the maximum that precedes the principal minimum. There is a slight inflection in the light curve on the descending branch, not constant, but perhaps periodic. The period of the variable was found to be: $p = 1^d 4^h 41^m 11^s\cdot 32 = 1^d\cdot 19527$. This is higher than that of Nijland by $0^s\cdot 86$. J. J. S.

1148. Two New Bright Hydrogen-Line B5-Type Stars. W. J. S. Lockyer. *Roy. Astron. Soc., M.N.* 91. *pp.* 187–191, *Nov.*, 1930.—Bright hydrogen lines have been detected for the first time in the following two stars of the spectral type B5: (1) H.C.D. 138749, θ Coronæ Borealis Mag. 4·17; (2) H.D.C. 224544, Andromeda, Mag. 6·36. The spectral nomenclature of the first star, according to the ruling made by the International Astronomical Union, will now have to be written as B5*ne*ζ; that of the second star as B5*ne*β. H. L. B.

1149. U Cephei: An Anomalous Spectrographic Result. E. F. Carpenter. *Astrophys. J.* 72. *pp.* 205–220, *Nov.*, 1930.—Thirty-four spectrograms of the bright component of the eclipsing variable U Cephei, in spite of the broad, shallow lines and the resulting large probable error of a single observation (13 km./sec.), yielded, by reason of a large range in velocity (220 km./sec.), a satisfactorily defined velocity-curve, the elements from which indicate an orbit of abnormally high eccentricity (0·474) whose major axis is inclined approximately 65° to the line of sight. Earlier photometric data, largely influenced by a shallow secondary minimum near mid phase, have indicated a circular orbit, but constancy of duration of eclipse and the nature of the variation of the period seem to preclude a reconciliation of the two sets of data by the assumption of a rotation of the line of apsides which should bring it into coincidence with the line of sight at the photometric epoch. The period is shown to increase steadily, with an oscillation of a few seconds' amplitude and an irregular period of about a dozen years. The usual methods for photometric orbits are extended to include cases where spectrograms have indicated orbits of high eccentricity. AUTHOR.

1150. Intensities in Stellar Spectra of a Triplet of SiIII. O. Struve and C. T. Elvey. *Astrophys. J.* 72. *pp.* 267–276, *Nov.*, 1930.—It is shown that under certain assumptions the ratios of total absorptions of the members of the SiIII triplet (2^1s—3^3p), $\lambda\lambda$4553, 4568 and 4575, in stellar spectra, depend upon the form of the absorption coefficient. If the latter is caused by radiation damping, then the total absorptions are proportional to the square roots of the laboratory intensities. If thermal agitation or any other cause produces a flat but extended absorption coefficient, then the total absorptions are directly proportional to the laboratory intensities. Observations of seven stars confirm the square-root relationship. This is an agreement with the assumption that the absorption coefficient is due to radiation damping, and tends to confirm the hypothesis that dish-shaped lines in early type stars are due to rotation and not to an unusual form of the absorption coefficient. The intensities in emission were observed in the spark between terminals of fused silicon. The observed ratios are 4·0 : 2·4 : 1, while the theoretical rules give 5 : 3 : 1, The deviation may be real. It is noted that stellar spectra are

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relatively more suitable for the study of faint members of multiplets than are laboratory sources. The stellar intensity ratios are independent of the absolute magnitude of the stars. AUTHORS.

1151. Determination of the Orbit of a Distant Star. N. Stoyko. *Comptes Rendus*, 191. *pp.* 996–998, *Nov.* 24, 1930.—The determination of the orbit of a distant star from three observations even to first approximation is insufficient, the time interval being relatively small, while the variation in the coordinates is large. Equations are established for use in calculating the orbit, and a solution of these is possible by Cauchy's method or that of least squares. If a long time interval is chosen the influence also of derivatives of the third order can be partly eliminated. A modified form of the equations is given for use when the orbit is required only to a first approximation, and to this corrections of the second order can be applied. R. S. R.

1152. Galactic Rotation Derived from Radial Velocities. M. Kaburaki. *Phys. Math. Soc. Japan. Proc.* 12. *pp.* 275–278, *Nov.*, 1930. *In English.*—The author classifies 2282 stars within 30° from the galactic equator and with radial velocities less than 100 km./sec., from Voûte's Second Catalogue of Radial Velocities in groups O, B, A, F, G, K, M, N, R, S and nebulæ, and, correcting by Campbell and Moore's value for the solar motion, gets the radial velocity $\Delta v = K + rA \cos^2 b \sin 2(l - l_0)$, where the first term indicates the K-term and the second the galactic rotation. The terms k, rA and l_0 are tabulated for the groups; M stars have galactic centre in direction 24 ± 13, and all the others in about 325°; the K-term for the main spectral types excluding G have values near 0 km./sec., but N, R and nebulæ are about + 5 km./sec., S about − 24·7 km./sec., indicating that these are of different kinds. He also tabulates for stars having proper motions less than 0″·100 per year, the values $\overline{m}$, $\overline{\mu}$, $\pi_{m_1\mu}$ and A; the mean parallaxes are obtained from the mean apparent magnitudes and mean proper motions by use of van Rhijn's table, so as to determine the rotation coefficient A; this is nearly intermediate for all groups in which the distance is well ascertained and the rotation coefficients are of an almost equal value. A. S. D. M.

1153. Proper Motions of Some Very Faint Stars. A. van Maanen. *K. Akad. Amsterdam, Proc.* 23. 9. *pp.* 1015–1022, 1930.—Eastman 40 plates have been used in rephotographing 42 of Kapteyn's Selected Areas, first taken by Fath and Babcock between 1909 and 1912; they have been compared in the blink-arrangement of the stereocomparator and the motions so found range from 0″·041 to 0″·925 per year. The brighter stars show a larger proper motion in the mean than the fainter, but there is a surprising lack of correlation between the size of proper motion and galactic latitude; tables are given. The stars are divided into three groups of magnitude, and three methods (Herschel's, Bessel's and Airy's) are used for determining the antapex for each group; tables are given for the antapex, and for the mean parallaxes of stars with $\mu < 0''\cdot100$, $\mu = 0''\cdot100$ to $0''\cdot299$ and $\mu = 0''\cdot300$ to $0''\cdot499$. The author checks his results by the proper motions of faint stars published by Ross and Wolf. There seems to be no indication of any value for the antapex declination larger than − 30° or − 35°. A. S. D. M.

LIGHT.

1154. Measurement of Apparent Parallelism in Binocular Vision. A. de Gramont. *Rev. d'Optique*, 9. *pp.* 433–438, *Nov.*, 1930.—This work continues a previous investigation [see Abstract 563 (1930)], and seeks to show that by an examination of two straight lines in normal vision the same phenomenon of convergence is produced. Certain measurements of Helmholtz are confirmed, experiments indicating that when two vertical elements are observed in such a way that each may only be perceived by one eye, they appear parallel, when in reality they slowly converge upwards. The angle found was practically the same as that measured from the Hellenic monuments. H. H. Ho.

1155. Colour Vision. H. E. Roaf. *Nature*, 126. *pp.* 825–826, *Nov.* 22, 1930.—A summary is given of experiments made to find the varieties of receptors present in the retina of persons with normal vision and of hypochromats. These facts can be explained by assuming the presence of three sets of receptors, (*a*) one which is stimulated by the whole of the visible spectrum and this may correspond with the sensation curve of the dark adapted eye, (*b*) one which is stimulated by long and medium wave-lengths from the extreme red end to about 4900 Å., (*c*) one which is stimulated by long wave-lengths from the extreme red end to about 5800 Å. That the short wave-length end of the spectrum stimulates a special mechanism is shown by measurements of visual acuity. The three sets of receptors might be explained on the basis of three photochemical substances, or of one photochemical substance with coloured filters in front of the receptors. The latter explanation receives support from comparative anatomy. The discovery of such coloured globules in the fovea of the human retina would explain the facts of colour vision. It is suggested that at the periphery of the eye the rods may be the structures stimulated by the whole of the visible spectrum, instead of cones with colourless globules so acting. R. S. R.

1156. Critical Frequency Measurements in Anomalous Trichromatic Vision. H. A. Blair. *J.O.S.A.* 20. *pp.* 601–615, *Nov.*, 1930.—Critical frequency measurements for the light adapted anomalous trichromatic eye were made on spectra of fourteen intensities. No Purkinje effect was observed. The Ferry-Porter law is apparently obeyed, but the branches of the Porter graphs are more numerous than for normal vision. The results are interpreted by Allen's visual reflex theory. Critical frequency measurements at points from the fovea toward the temporal periphery for three wave-lengths in the yellow fall on three distinct curves. The ends of the first two probably mark the boundary of the fovea and the macula lutea respectively. One peripheral normal curve is given. AUTHOR.

1157. Liquid Light Filters for Producing Artificial Sunlight. R. Luther. *Zeits. f. wiss. Phot.* 29. 1–12. *pp.* 234–238, 1930.—The preparation and properties of a copper glycocoll solution for use in "sunlight" filters are described. Its advantages and disadvantages compared with substances customarily used are investigated. Copper, cobalt and copper-ammonium sulphates, and copper glycocoll containing the correct proportions of water of crystallisation can be prepared in desiccators with the appropriate two-phase, water-vapour buffers, such as moistened zinc sulphate, potassium chloride, or sodium nitrate. C. B. A.

1158. Colorimetry without Comparison Solutions by Means of Bloch's Leucometer. L. Hock and H. J. Müller. *Zeits. f. wiss. Phot.* 29. 1–12. *pp.* 262–266, 1930.—The leucometer consists of the photometer head of a Martens blackening meter, fitted above the eyepiece orifice with a series of red, green and blue light-filters. For any substance to be examined a calibration curve is traced from the results of measurements of the percentages of light transmitted by layers of standard depth of definite concentration, the proper light-filter being interposed. By using the red filter disc satisfactory results are obtainable with solutions of nickel sulphate, cobalt nitrate and copper sulphate. T. H. P.

1159. Optical Constants of Manganese Distilled in Vacuum. J. B. Nathanson. *J.O.S.A.* 20. *pp.* 593–596, *Nov.*, 1930.—The distilled manganese was found to be brittle and difficult to polish. The final polishing was effected on the polishing wheel, first using aluminium oxide and ending with magnesium oxide. The optical constants were measured by means of polarised light at angles of incidence of 45° and 60°, the phase difference of the resulting elliptical polarisation being measured by means of a Babinet compensator. The reflecting power R was computed for normal incidence in terms of the refractive index n and the coefficient of absorption k, observations having been made for six different wave-lengths in the visible spectrum. The values of k for distilled manganese are in fair agreement with results obtained by previous investigators. There is some divergence in the values of n and R in the blue end, but it is difficult to account for this as the purity of the manganese used by previous workers has not been stated. The reflecting power of the distilled manganese is greater in the blue end of the spectrum and slightly less in the red end than that obtained by other investigators. The distilled manganese mirrors always remain silvery white in appearance. W. C. S. P.

1160. Determination of the Optical Constants of Metals in the Ultra-Violet by the Interference Method. J. Malsch. *Ann. d. Physik,* 7. 3. *pp.* 360–374, *Nov.* 10, 1930.—A method is described of measuring the optical constants of metals in the ultra-violet with the help of change of phase at reflection and it is shown that the measurement is at least capable of the same accuracy as that of the hitherto used methods in which polarisation spectrometers are used. The advantage of the method is that no polarisers and compensators are used and that it is also applicable in the ultra-violet. J. J. S.

1161. Refraction of Beams of Rectilinear Rays. A. Dargenton. *Comptes Rendus,* 191. *pp.* 770–771, *Nov.* 3, 1930.—Considers p surfaces of any form separating media with indices of refraction $n, n_1, \ldots, n_{p-1}, n'$. A conical beam starts from A in the first medium (n), having solid angle ω, and is refracted at each of the surfaces in turn, emerging in the last medium (n'). Let σ' be the normal section of this emergent beam at a point A′ in the mean ray. A conical beam with solid angle ω' starting from A′, having the same mean ray as the first beam, will pass back through the system, and the mean ray will pass through the point A in the first system. If σ be the normal section of this beam at A, then $n^2\omega\sigma = n'^2\omega'\sigma'$. This formula makes it possible to prove easily and simply the known law of the conservation of brightness through any optical system. H. N. A.

1162. Density and Refraction of Crystalline Ammonium Halides. P. Wulff and H. K. Cameron. *Zeits. f. phys. Chem.* 10. *Abt. B.* 4–5. *pp.* 347–368, *Nov.*, 1930.—The densities and refractive indices of the four modifications of the ammonium halides stable at room-temperature are measured and the molecular refractions determined. The values for $R_{\text{crystal}} - (R_{\text{kation}} + R_{\text{anion}})$ follow the same rules as the corresponding values for the alkali halides. The refractometric data give no definite ground for the assumption that any displacement of the protons of the NH_4^+ in the direction of the halogen ion occurs in the chloride, bromide and iodide, but in NH_4F they would suggest a displacement of a proton towards the F^-, which is not great enough to produce a molecular lattice. As in the case of the Cs salts, the intensification of the refraction effect is clearly seen for the NH_4 halides on passing to lattice type of higher coordination number. C. B. A.

1163. Dirac's Theory of Light Scattering and Dispersion. I. Tamm. *Zeits. f. Physik,* 65. 11–12. *pp.* 705–708, 1930.—It is shown that the scattering of the radiation at a pair of electrons with the result of the origin of a quantum at both electrons is possible only in the special case already treated by Dirac. Moreover, attention is drawn to the importance of the consideration of the anti-symmetry of the wave function for the consistent treatment of this case. J. J. S.

1164. Quantum Mechanics of Dispersion and Magnetic Rotation in Dirac's Theory of the Electron. W. Kroll. *Zeits. f. Physik,* 66. 1–2. *pp.* 69–108, 1930.—The author gives the detailed mathematical theory of dispersion in the single electron case, taking into account electron spin and relativity correction. The four-component wave equation of Dirac is taken as basis, and the problem is treated by perturbation methods. A special method is developed to obtain the dispersion formula, taking into account the continuous eigenvalue spectrum. In a second part the theory of the rotation of the plane of polarisation of the light in an external magnetic field is worked out on the same lines. The results confirm and extend previous investigations based on less general assumptions. W. S. S.

1165. Anomalous Dispersion of Crystalline Lead Chloride in the Region of Its First Characteristic Frequency. K. Hecht. *Zeits. f. Physik,* 66. 5–6. *pp.* 339–344, 1930.—The anomalous dispersion of crystalline lead chloride through its first ultra-violet absorption band is measured by placing a thin layer of crystals in the path of one beam in a simple Young interferometer, the resulting interference system being examined spectroscopically (method of Puccianti). Despite the large mean error in the results (9 in the second decimal place), the anomaly is clearly shown. The centre of the anomaly is found to be slightly displaced towards the red with regard to the head of the absorption band. C. B. A.

1166. Dispersion of KBr Crystals in the Infra-Red. E. Gundelach. *Zeits. f. Physik,* 66. 11–12. *pp.* 775–783, 1930.—The refractive index of KBr is measured for wave-lengths from $0 \cdot 8$ to $28 \cdot 5\,\mu$. Up to $18\,\mu$, the results are obtained in terms of the precision measurements of Paschen on KCl; from 18 to $28 \cdot 5\,\mu$ the measurements are made using an

air-plate interferometer. These measurements have a practical application, since large prisms can be made out of KBr (*e.g.*, 60°, 8 × 10 cm. side).
A. C. M.

1167. Magneto-Optical Dispersion of Organic Liquids. Part I. Normal Butyl Alcohol, Isobutyl Alcohol, and Propionic Acid. E. Stephens and E. J. Evans. *Phil. Mag.* 10. *pp.* 759–785, *Nov.*, 1930. —The magneto-optical rotations and refractive indices of butyl alcohol, isobutyl alcohol, and propionic acids are determined for various wave-lengths in the visible and ultra-violet. The magneto-rotatory dispersions of the two alcohols can be represented by single term equations of the Richardson type, which indicate that the wave-lengths of the absorption bands controlling the magnetic rotation are about the same at 0·1150 μ. The same value is obtained from the two simple Ketteler-Helmholtz equations which fit the values of the refractive indices. The magneto-rotatory and natural dispersions of propionic acid can also be represented by simple equations giving equal values for the wave-length of the absorption band at 0·1051 μ. From these results, the value of e/m is determined for each liquid. The results are rather lower than the accepted value, but show that the electron is the resonator.
C. B. A.

1168. Rotatory Power of Compounds of Tartaric Acid and Copper. J. Giuntini. *Comptes Rendus*, 191. *pp.* 778–779, *Nov.* 3, 1930. —Gives a table showing the specific rotatory powers, α, for wave-lengths 5780, 5460 and 4358 Å. for different proportions of tartaric acid and $Cu(OH)_2$. For green light α rises to a maximum as the proportion of $Cu(OH)_2$ increases, and finally becomes negative (left-handed); the corresponding dispersion is abnormal. The colour changes from very pale blue to intense blue. The solutions are nondichroic for TCu, ($T = C_4O_6H_4$), strongly dichroic for TCu_2. The solution of TCu_2 is definitely acid. The effect of NaOH and of NH_4 on the rotation of this solution has been studied.
H. N. A.

1169. Paramagnetic Rotatory Power of Xenotime Crystals at Very Low Temperatures, and Paramagnetic Saturation. J. Becquerel and W. J. de Haas. *Comptes Rendus*, 191. *pp.* 782–784, *Nov.* 3, 1930.—Measurements are described of rotatory power parallel to the optic axis of xenotime and in a spectral region far from the absorption bands. The rotations are studied as a function of H/T, (H = magnetic field, T = absolute temperature). At temperatures obtainable with liquid helium, and in a field exceeding 20,000 gauss., paramagnetic saturation is almost complete. The curves for T = 4°·22 and T = 1°·38 have the same asymptote, but differ from one another. The latter curve lies below the former, and the separation is much greater than experimental error. The two tangents at the origin are not the same. It follows that the fraction of saturation is not a function of the single variable H/T, as it is in the case of tysonite and parisite. Experiments at intermediate temperatures show that the transition from one curve to the other is continuous. The curve at 1°·38 is certainly not a hyperbolic tangent nor a Langevin curve, whereas that at 4°·2 approximates to the form of a hyperbolic tangent corresponding to a value of the magnetic moment greater than 6·5, but less than 7 Bohr magnetons. The curve obtained at 14°·34 can be represented much more closely by a hyperbolic tangent

with a moment about 7 magnetons. This gives a percentage saturation of 70·5 % in the maximum field employed (26,730 gauss.). The calculated asymptote is also about 3° higher than those found at the lower temperatures, which points to a change in the absorption of the active band.
C. B. A.

1170. Paramagnetic Rotation in Uniaxial Crystals of Rare Earths. H. A. Kramers. *Comptes Rendus,* 191. *pp.* 784–786, *Nov.* 3, 1930. —In this paper paramagnetic rotation is considered from the point of view of Becquerel [see Abstract 3331 (1929)] that the metallic ions are in a very intense electric field which is symmetrical about the optic axis of the crystal. In a direction and a field parallel to the optic axis the rotation in tysonite can be represented with great accuracy by a simple expression of hyperbolic tangent form, which can be explained by considerations of the electron levels in the cerium ion. The theory also predicts the existence in tysonite of a paramagnetic rotation normal to the axis. In xenotime at low temperatures, the rotation does not follow the simple hyperbolic tangent law, but the theory leads to a modified formula which agrees with it at temperatures above 4° Abs. C. B. A.

1171. Law of Paramagnetic Rotation in Xenotime and Its Experimental Verification. J. Becquerel, W. J. de Haas, and H. A. Kramers. *Comptes Rendus,* 191. *pp.* 839–841, *Nov.* 10, 1930.—The two formulæ proposed [see the two preceding Abstracts] are tested experimentally and the results verify the theory convincingly. Xenotime contains principally the rare earths gadolinium and erbium. The value 7 for the number of Bohr magnetons indicates that the rotation is due entirely to the gadolinium ions. C. B. A.

1172. Magnetic Rotatory Power of a Uniaxial Crystal in Directions Inclined to the Axis: Determination of the Rotation of Tysonite in a Direction near to a Binary Axis, at the Temperature of Liquid Nitrogen. J. Becquerel. *K. Akad. Amsterdam, Proc.* 33. 9. *pp.* 913–925, 1930. *Comm. No.* 211*a from the Phys. Lab., Leiden. In French.*—A theory is developed of magnetic rotation in the various directions in a plane containing the optic axis and a binary axis when the magnetic field is parallel to this plane. The experimental procedure by which it is tested in tysonite is described. The law derived is shown to agree with experiment, but only where the effect is linear, and a general law applicable to large values of H/T remains to be found. The experiments also show that the ratio of the rotatory power normal to the axis to that along the axis is much less at 77°·5 Abs. than at ordinary temperatures, but there is some uncertainty in this comparison in that in the experiments at 293° Abs. the normal to the optic axis was also near to a diagonal binary axis, but not necessarily the same axis. Although the crystal is optically uniaxial, it is not at all certain that the paramagnetic rotation will be the same in all directions normal to the optic axis. C. B. A.

1173. Paramagnetic Rotatory Power of a Crystal of Tysonite in a Direction Normal to the Optic Axis, at Temperatures Obtainable with Liquid Hydrogen. J. Becquerel and W. J. de Haas. *K. Akad. Amsterdam, Proc.* 33. 9. *pp.* 926–936, 1930. *Comm. No.* 211*b from the Phys. Lab., Leiden. In French.*—Two methods of measuring paramagnetic rotation normal to the axis are described. At very low temperatures the second method only can be used. The two methods

give results which are in good agreement so that the second (apparently less accurate method) can safely be used for the temperatures obtained with liquid helium. A still smaller value is found at 14° Abs. than at 77° Abs. for the ratio of rotatory powers normal to and along the axis.
C. B. A.

1174. Magneto-Optic Anisotropy of a Hexagonal Crystal in a Plane Normal to the Optic Axis. Paramagnetic Rotatory Powers and Magnetic Moments in Directions Near to Binary Axes at Very Low Temperatures. J. Becquerel and W. J. de Haas. *K. Akad. Amsterdam, Proc.* **33. 9.** *pp.* **937–948, 1930.** *Comm. No.* **211***c from the Phys. Lab., Leiden. In French.*—Describes an investigation of the paramagnetic anisotropy normal to the axis [see two preceding Abstracts], tysonite again being used. By working at about 1°·7 Abs. the region in which the paramagnetic rotation is a linear function of H/T is avoided. The measurements are extremely difficult, and the first results only showed that at this temperature the rotation normal to the axis is no longer proportional to the field, although the departure from the linear law is less than that along the axis. Further experiments led to the result that the curves of the rotation plotted against H/T for two symmetrical positions of the magnet-crystal system with regard to the light beam show striking curvatures. These can only be attributed to very complex effects, and prove the existence, when the field has not reached its maximum intensity, of a component of the rotation along the axis. This means that the angle between the field and the axis, while remaining near $\pi/2$, is a function of the intensity of the field. It is thence concluded that the magnetic rotations along the two types of binary axis are different. This is the first example of such an anisotropy in a plane normal to the optic axis of a uniaxial crystal. There is an extreme probability of a law of hyperbolic tangent form for the rotations normal to an axis. As is to be expected, the saturation rotations are the same for the two types of binary axis. The precision of these results is discussed, and finally the value of the ratio of rotatory power normal to and along the axis is again found to have decreased with the temperature, being much less than the value at 14° Abs.
C. B. A.

1175. General Theory of Paramagnetic Rotation in Crystals. H. A. Kramers. *K. Akad. Amsterdam, Proc.* **33. 9.** *pp.* **959–972, 1930.** *In French.*—A general examination is made of the optical properties of a birefringent crystal which possesses magnetic rotatory power. A theorem is then demonstrated which deals with the properties of an atomic system in a field of purely electrical origin, and it is shown that the energy levels undergo double degeneration if the number of electrons in the system is odd. The effect of a magnetic field on a degenerated atom is then examined, and the paramagnetic rotation in a crystal containing such atoms is discussed. Finally, the effect of the magnetic interaction between the atoms on the paramagnetic rotation in a crystal is investigated.
G. E. A.

1176. Detectability of Flow Double Refraction in Very Low Concentrations. H. Freundlich, J. V. Tamchyna and H. Zocher. *Zeits. f. wiss. Phot.* **29. 1–12.** *pp.* **102–109, 1930.**—The limiting concentrations at which this phenomenon [see Abstract **671 (1916)**] is detectable macroscopically and microscopically have been determined for various sols. With sols of vanadium pentoxide, ferric oxide, tungsten trioxide, cotton yellow GX, benzopurpurin 4B and 6B, and aniline blue, flow anisotropy is observable with concentrations of the order 10^{-6} gm. per c.c., but with sols of alumina and titanium dioxide, the minimum limiting concentrations are considerably higher. T. H. P.

1177. Thermal Variation of the Magnetic Birefringence of Para-Azoxyanisole above the Temperature of Disappearance of the Mesomorphic State. Jacqueline Zadoc-Kahn. *Comptes Rendus,* 191. *pp.* 1002–1004, *Nov.* 24, 1930.—This paper continues a previous investigation [see Abstract 2797 (1930)] where the curve for the Cotton-Monton effect on p-azoxyanisole in the liquid isotropic state has been obtained between 134·5° C. to 172·6°, the point of disappearance of the nematic state being 133·1°. The thermal conditions have now been more closely investigated, since it has been established that a prolonged or too intense heating changes the substance. The maximum birefringence observed in the immediate neighbourhood of the transformation point is about 90°. Under the same conditions the magnetic birefringence of nitrobenzene is only 1°. It is thus apparent that a substance which possesses a nematic state acquires considerable birefringence when placed in the isotropic state in a magnetic field which varies hyperbolically with temperature. Cotton's theory of molecular association is utilised to explain the thermal features of the diagram now obtained. H. H. Ho.

1178. Measurement of Polarisation of the Tyndall Beam of Aqueous Suspensions as an Aid in Determining Particle Size. T. Hatch and Sarah P. Choate. *Frank. Inst., J.* 210. *pp.* 793–804, *Dec.*, 1930.—The relation between particle size and the degree of polarisation of the Tyndall beam created by suspension of non-uniform particulate substances is investigated for three materials (silica, granite and calcite) ranging in size from 1 to 50 μ. The degree of polarisation is found to be a function of the arithmetic mean diameter of the material. The optical property of birefringence is also found to be a determining factor, although its effect is not studied quantitatively. It is shown that by combining the equation expressing the relation between the particle size and the strength of the Tyndall beam with the mathematical relation between degree of polarisation and particle size, an indirect method of obtaining a complete definition of particle size is given. Particle size values calculated from observed Tyndall readings and measurements of polarisation are found to be within approximately 10 % of observed values. C. B. A.

1179. Scattering of Light in Protein Solutions. Part I. Gelatin Solutions and Gels. K. Krishnamurti. *Roy. Soc., Proc.* 129. *pp.* 490–508, *Nov.* 3, 1930.—The Tyndall number and the depolarisation factor of gelatin sols and gels have been measured at different temperatures, with different concentrations, and different values of pH. The gelatin sols cannot be regarded as purely colloidal dispersions, in which lowering the temperature brings about aggregation, increasing the light scattering capacity of the system. According to this view the increase in the Tyndall intensity should be more pronounced in concentrated sols, which is not the case. The author considers, on the contrary, that these sols are polydisperse systems, in which the proportion of molecularly dispersed gelatin increases with the dilution of the sol, the rest of the gelatin exists as polymolecular micelles. Cooling below 20° C. has the effect of producing supersaturation, as a result of which loose molecular aggregations of gelatin are formed. As a result of this the ratio of the Tyndall number in the gel state to that in the corresponding sol, which is a measure of the amount of molecular gelatin which has aggregated, is greater in dilute sols than in concentrated ones. When sols of different concentrations are cooled to 10° the depolarisation, θ, at first decreases and then increases; this effect is more pronounced in dilute sols; it is due to the changes which take place in the shape and the size of the particles, an increase in size increases θ, an increase in spherical symmetry diminishes θ. H. N. A.

1180. Sharpness of the Image for an Axial Symmetrical Series with Finite Size of the Beam. H. Boegehold and M. Herzberger. *Zeits. f. angew. Math. u. Mechanik,* 10. *pp.* 585–594, *Dec.,* 1930.—The relations established by Lihotzky are first considered, and mathematical expressions are then obtained for the sharpness of images for large bundles of rays in the cases of a surface element, two perpendicular and two curved surface elements. R. S. R.

1181. Dependence of the Seidel Image Errors on the Position of the Object. M. Herzberger. *Zeits. f. techn. Physik,* 11. 11. *pp.* 455–458, 1930. *Paper read before the Deut. Phys. u. Math., Königsberg, Sept.,* 1930.—The author discusses errors arising from spherical aberration, coma, astigmatism and curvature of the field and the dependence of these on the magnification. From these general considerations he states a number of conditions which have to be satisfied if these errors are to be avoided. R. S. R.

1182. Adjacent Images with Lenses. H. Schulz and H. Schuch. *Zeits. f. Physik,* 66. 5–6. *pp.* 389–395, 1930.—The width of the intersection is calculated for adjacent images with two-lens systems and a graphical solution provided for the case of two plano-convex lenses. It is shown how by a proportionately small change of distance the adjacent images can be avoided. Its importance arises with spectrographic objectives and especially with those for ultra-violet light. R. S. R.

1183. Parallax Panoramagrams with a Large Diameter Concave Mirror. H. E. Ives. *J.O.S.A.* 20. *pp.* 597–600, *Nov.,* 1930.—On account of the great practical difficulties in constructing a lens of aperture F/1 and focal length 24 in., a concave mirror is used in combination with a grating slightly separated from the sensitive plate. A semi-transparent reflector covers the whole width of the concave mirror and gives only a single image. The astigmatic aberration of the image is minimised by the small effective aperture of the mirror used by the two eyes in any one viewing position. Lenses can be used to enlarge the area of good definition. A modification of the large mirror scheme can be constructed to make parallax panoramagrams and is illustrated. The apparatus is more compact and self-contained than the moving lens device [see Abstract 3708 (1930)]. R. S. R.

1184. Optical Process for Fourier Analysis. B. Germansky. *Ann. d. Physik,* 7. 4. *pp.* 453–469, *Nov.* 20, 1930.—A curve is traced in some opaque substance on a plane mirror, on which a parallel beam of light falls at an acute angle. A Meisenbach process plate is placed in contact with the curve, and the reflected beam is then broken up into a " spectrum " showing lines for each of the constituent oscillations which form the curve. The author gives a theoretical discussion of the method and practical instructions for carrying it out. E. E. F. d'A.

1185. Correlation of the Shade Numbers and Densities of Eye-Protective Glasses. W. W. Coblentz and R. Stair. *J.O.S.A.* 20. *pp.* 624–626, *Nov.*, 1930.—In connection with an extensive campaign for the protection of the eyes of workers from injurious radiation, the Federal specifications for eye-protective glasses have recently undergone a revision. The present paper gives technical data proposed to and adopted by the Technical Committee appointed to write these specifications. The new specifications permit a continuous gradation of shades, without loss of material which is advantageous to both the producer and the consumer. The adoption of a fixed scale of densities gives assurance of uniformity of production and labelling that cannot be changed at the whim of a manufacturer or user of eye-protective glasses. AUTHORS.

1186. Multiplex Interference Spectroscope. E. Gehrcke and E. Lau. *Phys. Zeits.* 31. *pp.* 973–974, *Nov.* 1, 1930. *Paper read before the Deut. Physikertag., Königsberg, Sept.*, 1930.—Describes an instrument, built on the plan given recently by Lau [see Abstract **101** (**1931**)]. A diagram is given showing the way in which the two slightly silvered plane parallel glass plates are mounted, and the adjustments for the same. Photographs of the whole apparatus, of the fine structure of the 5461 Å. Hg line, and of the photometric curves of the measurements of the components are reproduced. The thicknesses of the plates are 9·9 mm. and 3 mm., and the resolving power is at least one million. If the plates were twenty times as thick, the resolving power could be made over twenty millions, and it would be possible to measure the Doppler effect produced by a running bicycle. H. N. A.

1187. Spectrograph with a Non-Inclined Photographic Plate. A. Couder. *Comptes Rendus*, 191. *pp.* 772–774, *Nov.* 3, 1930.—For work in the ultra-violet, achromatic lenses of quartz-fluorite have been employed to avoid having to incline the photographic plate; but good specimens of fluorite are rare. Quartz-water lenses are difficult to work with. The author has devised a type of spectrograph in which achromatism is obtained with a single material, quartz for example, by using a catadioptric lens. The principle of the autocollimating spectrograph (Dubosq, Littrow) is employed. This ordinarily has an objective, a prism and a plane mirror; but the author uses a simple converging lens, and substitutes for the plane mirror a diverging meniscus lens the convex posterior surface of which is silvered. Shows how the curvatures of the four lens surfaces can be adjusted to obtain achromatism. The other aberrations of the system can be also sufficiently corrected by arranging these curvatures suitably. A trial spectrograph has been constructed on this principle, using glass lenses and prism, and works satisfactorily. H. N. A.

1188. New Photoelectric Recording Microphotometer. J. A. Carroll and E. B. Moss. *Roy. Astron. Soc., M.N.* 91. *pp.* 191–200, *Nov.*, 1930.—The instrument described is in the main an adaptation of the Dobson-Skinner microphotometer. The measuring cell is an Osram Cs on Ag cell, which is sensitive well into the infra-red and operates with ease when coloured filters are used, while it is connected to a Lindemann electrometer. The width of the slit even for the finest work is still so large that inaccuracies of the edges have little or no effect. The instru-

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ment performs all the functions of existing instruments, but gives greater speed of working, greater sensitivity and increased adaptability and range. Examples are given of its use for (1) contours of Fraunhofer lines and (2) isophotic lines in a nebula. The relative importance of the waviness of the "background line" and of plate grain is discussed. The details of the instrument and its working are illustrated in plates. R. S. R.

1189. Absolute Intensity of the Aurora Line in the Night Sky. (Lord) Rayleigh. *Roy. Soc., Proc.* 129. *pp.* 458–467, *Nov.* 3 1930.—The standard instrument employed in measuring the green auroral light of the night sky was calibrated by determining the absolute intensity of the auroral light required to match the self-luminous working standard of potassium-uranyl sulphate. The instrument uses a special filter designed to isolate the green auroral line $\lambda 5577$ as nearly as possible. The brightness corresponding to the zero reading of the instrument is found to be $8 \cdot 65 \times 10^{-5}$ cp. per sq. m., which is the upper limit to the brightness of this line in any source giving this zero reading. The light transmitted by the filter consists, however, of two parts, the green line and a continuous background, the fraction attributable to the former being $0 \cdot 37$. Thus the brightness of the line becomes $3 \cdot 2 \times 10^{-5}$ cp. per sq. m., and the energy required to maintain this brightness is $6 \cdot 4$ ergs per sec. per sq. m. To supply this energy the number of atomic transitions required is $1 \cdot 81 \times 10^{12}$ per sec. per sq. m. R. C. F.

1190. Colour-Temperature Measurements: A New Colour Comparator for Incandescent Lamps. D. B. Judd. *Bureau of Standards, J. of Research*, 5. *pp.* 1161–1177, *Nov.*, 1930.—It is important in many kinds of scientific and technical research to know the colour-temperature of a source of light because for many common light sources it is possible to deduce from the value of colour-temperature the relative amounts of energy being emitted throughout the whole spectrum. Instead of measuring these relative spectral energies radiometrically for each incandescent lamp submitted for standardisation, it is, therefore, customary to compare the test lamp as to colour with a standard lamp previously tested radiometrically; that is, the colour-temperature of the test lamp is determined by comparison with a standard lamp. This comparison has been carried out at the National Bureau of Standards by means of either the 3° circular field of the rotatory dispersion colorimeter or the 6° circular field of the Martens photometer. Preliminary to the construction of a colour comparator which was to be designed to permit colour-temperature determinations with a maximum of precision an investigation was made of the effect on precision of various observing conditions. The conditions investigated included field size, width of dividing line and convenience of the brightness adjustment. It was found that the simple apparatus used for these preliminary tests could be made to yield colour-temperature determinations of more than double the precision previously obtainable by visual comparison at the Bureau of Standards. [See also Abstract 1418 (1924).] AUTHOR.

1191. Optical Sensitising of Silver Halides by Colloidal Silver. S. E. Sheppard. *Kodak Research Lab. Comm. No.* 442.' *Frank. Inst. J.* 210. *pp.* 587–607, *Nov.*, 1930.—After a critical discussion of existing theories on the optical sensitising of silver halides, it is suggested that the sensitising by colloidal silver (Becquerel effect) is primarily due to a sensitised photoelectric emission by silver amicrons and ultramicrons. Minute Volta condenser fields are regarded as the cause of this sensitised photoelectric emission of composite metal films. Finally, self-fields as the origin of the sensitised photoelectric effects are considered in relation to the Becquerel and Weigert effects with silver halides. R. C. F.

1192. Theory of the Latent Image. S. E. Sheppard. *Zeits. f. wiss. Phot.* 29. 1–12. *pp.* 8–20, 1930.—The theory of the latent image is discussed and the effects of sensitisers, such as thiocarbamides or isothiocyanates are described. The connection between external and internal photoelectric effects and photographic phenomena is considered, and the electron emission at greater wave-lengths of light than was formerly considered to take place is discussed in relation to the quantum theory. The paper is a critical discussion of recent work in this field and is not suitable for abstracting. F. J. B.

1193. Micelle Theory of the Latent Image. F. Weigert. *Zeits. f. wiss. Phot.* 29. 1–12. *pp.* 191–201, 1930.—The micelles, consisting of silver halide, water, gelatin and ur-silver, into which silver sulphide and dye molecules can enter, possess, when illuminated, an internal local energy accumulation. It is these micelles, rich in energy, which represent the latent image. The development is then an activation of the developer molecules by this energy accumulation resulting in a chemical intramicelle process. Special photographic effects are due partly to the peculiarities of the photo-micelle processes through which a large number of quanta can be absorbed by the same elementary particles, and partly to the optical structure of the micelle. Finally, the S-shape of the blackening curve is due to the development of the silver halide by the gelatin due to strong illumination, thus forming metallic silver, with a consequent reduction of the available energy. R. C. F.

1194. Photographic Preparation of a Blackening Scale and Sensitometry of Complementary Colour Pictures. W. Barth. *Zeits. f. wiss. Phot.* 29. 1–12. *pp.* 110–128, 1930.—A photographic method for obtaining a blackening scale with a difference of 0·15 is described, the means of overcoming difficulties due to irregularity of the film material and to variations in the developer being discussed. The scale is adapted to the sensitometry of complementary colour pictures. T. H. P.

1195. Accurate Photographic Rendering of Colour Tones. K. Jacobsohn. *Zeits. f. wiss. Phot.* 29. 1–12. *pp.* 202–208, 1930.—Briefly discusses the necessary factors for true rendering of colour tones by photographic means and then, by means of the " neutral colour circle " due to Matthai, illustrates the methods of improving orthochromatic and panchromatic plates. The best orthochromatic plates do not give even approximately correct tone renderings, but they can be greatly improved by the use of yellow filters to decrease the excessive blue-violet sensitivity. With panchromatic plates a yellow filter is also necessary, and this has often to be used with a blue filter in order to reduce the red sensitivity. This is necessary so that the ideal relationship—blue : green : red = 1 : 6·8 : 4·7—shall be realised. If the photography be performed with artificial light sources, more correct colour tone renderings can often be obtained without the use of filters, due to the favourable shape of the energy curves of the light sources. R. C. F.

1196. Sensitometry with Spectrum and Colour Plate. H. Arens and J. Eggert. *Zeits. f. wiss. Phot.* 29. 1–12. *pp.* 239–261, 1930.—The foundations of the colour-sensitometry of photographic films by means of the spectrum and colour plate are considered. Simple spectral photographs yield only qualitative comparisons of different films and no absolute data as to the spectral sensitivity. Such absolute data are obtainable only if either the energy of the separate spectral regions (for physical purposes) or the brightness of these regions (for practical photographic purposes) is taken into account. The representation of the spectral sensitivity curves in relation to the energy and to the brightness of the incident spectral light is described, and it is shown that for every photographic film there exists a typical form of such curves which characterises it definitely, assuming that the dependence of the blackening curve on the wave-length of the light used is to be neglected. These sensitivity curves serve for obtaining the blackening-distribution curves for spectra of any energy—and brightness—distribution and for judging of the correctness of the sensitisation and of the behaviour of films in reproducing natural, not spectrally-pure, colours. T. H. P.

1197. Resolving Power of Photographic Layers by the Contact Method. H. Stintzing. *Zeits. f. wiss. Phot.* 29. 1–12. *pp.* 266–280, 1930.—In the method here described use is made of an opaque wedge of 1° angle between transparent, equally broad lines more than 0·01 mm. in width, in conjunction with a micrometer scale and a Scheiner sensitometer. T. H. P.

1198. Luminescence of Decomposing Ozone. M. Trautz and W. Haller. *Zeits. f. wiss. Phot.* 29. 1–12. *pp.* 48–71, 1930.—COS and $COCl_2$ with ozone show faint luminescence at about 200°, although the mixture is readily explosive. Cl_2O, NO_2 and SO_3 show no effect. The decay of the luminescence of CO with ozone was recorded with a photographic film in conjunction with a photoelectric cell and a string electrometer. The course of this curve indicates a bimolecular reaction. Cl_2, Br_2 and NO_2 prevent the luminescence. Only one-fifth of the ozone reacts even with a stream of the gas at 220°–250°C. for a long time, and in a stationary mixture a much smaller proportion. The spectrum reaches from 400 $\mu\mu$ to 600 $\mu\mu$ and appears to be continuous. There is no appreciable alteration of the conductivity during luminescence. J. E.

1199. Residual Luminescence in the Infra-Red of Photoluminescent Crystals and Microcrystals. F. Martin. *J. de Physique et le Radium*, 1. *pp.* 401–403, *Nov.*, 1930.—A study of the well-known residual luminescence brought out in photoluminescent substances by infra-red excitation long after the extinction of phosphorescence. The sources and methods of excitation and observation are described and a number of qualitative results of observation on sulphide phosphors and on natural minerals. It appears that only phosphors showing an appreciable time of decay exhibit the effect. J. E.

1200. Nature and Size of the Luminescent Centre. J. Ewles. *Roy. Soc., Proc.* 129. *pp.* 509–519, *Nov.* 3, 1930.—After criticising Merritt's theory of the relation between concentration and brightness in solid solutions, the author develops a new theory based on simple assumptions in accord with known facts. This leads to the relation $F = Ace^{-nc}$, where c is the mole ratio of activator to solute, and n is the number of molecules in a luminescent centre. Experiments are described on various solid solutions which confirm this relation and in which the determination of the experimental relation between brightness and concentration leads to a knowledge of the number of solute molecules associated with the activator to form the luminescent centre. Further experiments are described with luminescent solutions of dyestuffs which appear to be in agreement with the theory, indicating that in liquid solutions also the luminescent centre consists of a definite number of solute molecules associated with one molecule of activator. J. E.

1201. Quenching of Fluorescence of Nitrogen Dioxide. W. P. Baxter. *Am. Chem. Soc., J.* 52. *pp.* 3920–3927, *Oct.*, 1930.—The intensity of fluorescence excited in nitrogen dioxide by the 4358 and 4047 lines of mercury has been determined for the pressure range 0·001 to 18 mm. Nitrogen dioxide is very efficient as a quenching agent, the fluorescence being half damped at a pressure of 0·02 mm. The product of the square of the effective diameter for collision and the life of the excited molecule is $9 \cdot 3 \times 10^{-21}$ cm.^{2} sec. This result indicates a deactivation diameter approximately ten times greater than kinetic theory values. It is shown that the quenching of this fluorescence by foreign gases is in quantitative agreement with the equation $J/J_0 = \frac{p_{NO_2}(I)_{p=p}}{p_{NO_2}(I)_{p=0}} = \frac{1}{cp+1}$, which is based on the occurrence of deactivating collisions with these gases as well as with nitrogen dioxide itself. There is a specific effect for each added gas, the relative efficiencies of carbon dioxide, nitrogen, oxygen and hydrogen referred to nitrogen dioxide as unity are 0·87, 0·29, 0·24 and 0·15 respectively. J. E.

1202. Magnetic Quenching of Iodine Fluorescence and Its Relation to Predissociation Phenomena. L. A. Turner. *Zeits. f. Physik*, 65. 7–8. *pp.* 464–479, 1930.—The dependence of the magnetic quenching of iodine fluorescence on the wave-length of the exciting light has been studied quantitatively. A fairly sudden setting in of the quenching is observed as the exciting light approaches the short wave end. This is taken to indicate that the effect is to be viewed as a magnetically induced predissociation, that is, a breaking through of a selection prohibition for radiation less transitions in a magnetic field. A discussion of the possible terms and processes shows that such an interpretation is not discordant with theory. A brief consideration is given in this relation to the connection between fluorescence and photochemical dissociation of NO_2 discovered by Norrish [see Abstracts 393 and 394 (1930)]. J. E.

1203. Excitation of Iodine Fluorescence with Monochromatic Light. L. A. Turner. *Zeits. f. Physik*, 65. 7–8. *pp.* 480–488, 1930.—The quantum numbers of molecules excited by light of any wave-length are considered generally, and the special cases of excitation with the two yellow lines 5771·2 and 5792·3 of Hg, the 5852·5 Neon line and the 5085·9 line of Cd are dealt with. J. E.

1204. Polarisation Phenomena in the Gradual Excitation of Mercury Fluorescence. E. F. Richter. *Ann. d. Physik*, 7. 3. *pp.* 293–328, *Nov.* 10, 1930.—An extension of the work of Richter and Hanle [see Abstract 3020 (1929)] on the absorption and re-emission of polarised lines in the visible spectrum of mercury vapour by atoms already excited by the resonance line. Examination of the polarisation and Zeeman effect of the various lines traced the colour effect observed in mercury with added nitrogen to the step-wise excitation of the excited state. A theoretical explanation of the changes is given and polarisation measurements on the lines confirms this interpretation. Orientation and depolarisation measurements enable the mean life in the excited state to be estimated. It was found impossible from measurements on the variation of the mean life with pressure of nitrogen to extrapolate to pure mercury vapour. J. E.

1205. Absorption and Fluorescence in the Formation of Salts of Substituted Cinnamic Acids. H. Ley and R. Dreinhöfer. *Zeits. f. wiss. Phot.* 29. 1–12. *pp.* 134–155, 1930.—Quantitative measurements of the absorption of *o*-oxy and *o*-amino-cinnamic acid and their alkaline salts show that down to 220 mμ their spectra consist of two bands. The power of fluorescence disappears with these bands. The very feebly fluorescent *p*-oxy-cinnamic acid has only one band. Other cinnamic acid derivatives which fluoresce usually show a long-wave as well as a short-wave band.
E. E. F. d'A.

1206. Phosphorescent Phenomena with Quartz-Glass Discharge Tubes. R. Zouckermann. *Comptes Rendus,* 191. *pp.* 776–777, *Nov.* 3, 1930.—Two different phenomena can be observed in fused silica which has been activated by the discharge. Working in the dark a bluish-green phosphorescence is observed, apparently due to ultra-violet rays. This can be renewed, even several months after, by means of ultra-violet rays. Even after this interval the tube shows thermo-phosphorescence. The author has endeavoured to distil off the coloured layer formed on the inside of the tube; no deposit is then formed on the cold parts. H. N. A.

1207. Relation of Phosphors to Metal Preparations Activated by Additions. R. Schenck. *Zeits. f. wiss. Phot.* 29. 1–12. *pp.* 219–229, 1930.—Points out that existing data on phosphors show that they consist of mixed crystals. Considers that there are two types: (1) simple mixed crystals consisting of solvent and solute as the parts, and (2) mixed crystals consisting of the metal ions of the solvent, the common anion and a complex such as $Ca_3Bi_2S_6$. The first type is formed when the grating spacings of solvent and solute are alike. In such a type it is considered that the effect of the exciting light is to remove an electron from the anion and add an electron to the kation, thus bringing about changes of ionic size and consequent distortions in the lattice which are removed with emission of phosphorescent light. In the second class the light absorbed affects the electronic structure of the complex ion alone. Experiments have been made on the reduction of metal oxides such as NiO by CO when these oxides are mixed with oxides such as MgO with which they can form mixed crystals when strongly heated. The experiments show that the formation of mixed crystals stabilises, sometimes completely, the otherwise reducible oxides. The experiments also indicate a heterogeneous mixture with consequent variation in the energy change at different parts of the mixed lattice and consequent variability in the wave-length required for excitation. This is taken to account for the different kinds of centres affirmed by Lenard. J. E.

1208. Light Emission of Alkali Halogen Phosphors. W. Bünger. *Zeits. f. Physik,* 66. 5–6. *pp.* 311–327, 1930.—According to the measurements of Hilsch, Pohl and Smakula, the light energy absorbed by an ionic crystal is wholly converted into chemical energy. With mixed crystals having a very small amount of one component the process of light absorption is different since here ultra-violet light excites fluorescence and phosphorescence. The work here described is a determination of the part of the absorbed energy which is re-emitted as light. A mixed crystal is illuminated with monochromatic light of known amount and the total amount of fluorescent or phosphorescent light given out is measured, as well as in various parts of the spectrum. The incident light energy and emitted light energy are measured with a thermocouple of great sensitivity. The following results have so far been obtained: (1) 50 to 80 % of the energy of the longer ultra-violet absorption band is re-emitted as ultra-violet fluorescence in a KCl crystal containing a small trace of Tl. There is no storing up of energy or phosphorescence. The remainder of the energy is given out in a visible band at 4700 Å. (2) Very similar results obtain for the shorter ultra-violet absorption band except that with higher Tl concentrations some portion of the absorbed energy is stored up and given out as phosphorescence. (3) Photochemical colouring has not been attributed yet either to the longer or shorter absorption band. J. E.

1209. Properties of Partially Conducting Cellules. W. Scislowski. *Acad. Polonaise Sci. et Lettres, Bull.* 4–5.*A*. *pp.* 151–158, *April–May,* 1930.—The method used was that of previous workers [see Abstract 2305 (1927)] modified by an arrangement whereby the current traversing the pastille (mercuric sulphate, 5–7 mm. thick, and 15 mm. diam.) was measured simultaneously with the intensity of radiation. The effect varied with the material of the electrodes; with silver or brass radiation was emitted only when the perforated electrode was connected with the anode; with aluminium when connected with either pole, but much more strongly when with the kathode. At pressures below 12 cm. mercury luminescence is visible in the portion of the pastille emitting radiation; this increases as the pressure decreases, and develops into scintillations when this is below 6 cm. Curves showing the variation with time of the current and of the intensity of radiation for the different electrodes, and for current for different p.ds. are given. The current attains a maximum in 2–4 min., this increases with increased p.d., but falls approximately to the same limit in 7–8 min. irrespective of the p.d. C. A. S.

1210. Waves and Corpuscles. S. Timpanaro. *Accad. Lincei, Atti,* 12. *pp.* 334–336, *Oct.,* 1930.—A short mathematical discussion based on the hypothesis, deduced from the photoelectric phenomenon and the Compton effect, that the corpuscle of light, or photon, has a quantity of motion $\overline{m}c = h\overline{\nu}/c$, where h is Planck's constant and c, $\overline{\nu}$ and $\overline{m}$ are respectively the velocity, frequency, and mass of the photon measured by an observer fixed with respect to the luminous source. J. J. S.

1211. New Effect of the Force of Light upon Matter. A. Deubner. *Phys. Zeits.* 31. *pp.* 909–911, *Oct.* 15, 1930.—The author attempts to explain the mechanism of the phenomenon of an increased Brownian movement under the influence of light, discussed by Pospišil in recent papers [see Abstract 2516 (1930)], in terms of the incidence upon the particles of light quanta which have already been once scattered before such incidence. J. S. G. T.

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1212. Wave Theory of Light Quanta. G. Rumer. *Zeits. f. Physik*, **65.** 3–4. *pp.* 244–252, 1930.—The place of Maxwell's equations in the general scheme of wave matrix mechanics is discussed. Just as in Dirac's theory first order equations are derived by linear factorisation of second order operators, so the author shows that Maxwell's equations can be derived from the second order equation for the potential ϕ^i subject to Lorentz's condition $\partial\phi^i/\partial x^i = 0$. J. S. G. T.

1213. Time of Absorption of Light Quanta. H. T. Wolff. *Zeits. f. Physik*, 65. 11–12. *pp.* 730–733, 1930.—Proposes the following test for the remanence (*Verweilzeit*) and decremental period (*Abklingzeit*) in the reception of a quantum by an atom. A canal ray which has lost a definite portion of its energy is exposed to bombardment by electrons whose energy would not suffice to excite a certain spectrum line. If the line is enhanced there is no remanence. E. E. F. d'A.

1214. Stern's Formula and de Broglie's Hypothesis as to the "Resting Mass" of Light Quanta. W. Anderson. *Zeits. f. Physik*, 66. 9–10. *pp.* 709–711, 1930.—Stern's formula for the equilibrium between matter and the energy of radiation can be made use of for deciding the question of the "resting mass" of light quanta. The following three hypotheses have been proposed in connection with this problem: (1) the resting mass is zero; (2) it is of the order of magnitude $10^{-50}g$, and the velocity of the quanta is a little less than the "limiting velocity" c (de Broglie's hypothesis); (3) the quanta have a variable "effective" resting mass. The author shows that the third hypothesis must correspond much more nearly with reality than either of the two others. H. N. A.

1215. Propagation of Light Waves in Accordance with the Heisenberg-Pauli Formulation of Quantum Electrodynamics. S. Kikuchi. *Zeits. f. Physik*, 66. 7–8. *pp.* 558–571, 1930.—It is shown that a light signal propagated in accordance with the Heisenberg-Pauli formulation of quantum electrodynamics [see Abstract 2435 (1930)] can never have a velocity exceeding c. The notion of wave-length or coherence length is developed in terms of quantum electrodynamic theory, and their relation to the life period of the atom is deduced. J. S. G. T.

1216. Energy Levels of Molecular Oxygen. J. C. McLennan, H. D. Smith and J. O. Wilhelm. *Roy. Soc. Canada, Trans.* 24. *Sect.* 3. *pp.* 65–86, *May*, 1930.—The absorption spectrum of liquid oxygen was investigated between 2200 Å. and 10,600 Å.; no new bands were found between 2200 and 3000 Å., but seven new ones were observed between 3000 and 10,600 Å., in addition to the ten previously recorded. There was also a faint indication of a weak band, with mean wave-length about 3925 Å. All of the bands between 3000 and 10,600 Å. seem to have their sharp edges on the side of longer wave-length; this is also the case in the atmospheric bands. Six bands have been observed in nearly the same positions as the above in solid oxygen, and a number of the bands observed in liquid oxygen have previously been observed in oxygen at ordinary pressures, and at 140 atmospheres. The authors divide the bands observed in liquid oxygen between 3000 and 10,000 Å. into five systems, the suggested electronic transitions being: (1) ${}^3\Sigma \rightarrow {}^1\Delta$, three bands in infra-red; (2) ${}^3\Sigma \rightarrow {}^1\Sigma$, four bands, $\nu^{\circ\circ}$ (cm.$^{-1}$) 13,122, $\lambda^{\circ\circ}$ Å. 7618; (3) ${}^3\Sigma \rightarrow C$, three bands, $\nu^{\circ\circ}$ (cm.$^{-1}$) 18,686, $\lambda^{\circ\circ}$ Å 5350; (4) ${}^3\Sigma \rightarrow D$, four bands, $\nu^{\circ\circ}$(cm.$^{-1}$) 20,914, $\lambda^{\circ\circ}$ Å. 4780; (5) ${}^3\Sigma \rightarrow E$, four bands, $\nu^{\circ\circ}$ (cm.$^{-1}$) 26,225, $\lambda^{\circ\circ}$ Å. 3812.

In order to explain the third, fourth and fifth systems it was necessary to suppose that there were three states of the oxygen molecule, with energies between those of the metastable $^1\Delta$ and excited $^3\Sigma$ states; these have been designated the C, D and E states; their energy levels are approximately 2·3, 2·6 and 3·2 volts respectively above that of the normal $^3\Sigma$ state. The bands of the $^3\Sigma \rightarrow {}^1\Delta$ system seem to be members of the infra-red band system predicted by Mulliken. System (2) bands are the same as those of the atmospheric oxygen system. H. N. A.

1217. Absorption Spectra of Rare Earth Double Nitrates. D. W. Pearce and J. A. Harris. *Roy. Soc. Canada, Trans.* 24. *Sect.* 3. *pp.* 145–151, *May*, 1930.—The efficacies of various double nitrates for the separation of the rare earths by fractional crystallisation have been investigated by measurement of the relative intensities of the characteristic absorption band of each element. For the separation of lanthanum and praseodymium from neodymium the double ammonium nitrates are the most satisfactory, whilst, although the double magnesium and double cobalt nitrates do not permit of a definite separation, their ease of crystallisation renders them of use for a preliminary rough separation of the more basic rare earths. The double manganese salts are recommended for the separation of samarium and neodymium. Preliminary results indicate that the double copper nitrates effect a reversal of the usual order of solubility, and should therefore be extremely effective for removing neodymium from samarium. The presence of lead nitrate does not appreciably influence the separation of the more basic cerium earths, but may be of use for the concentration of illinium. H. F. G.

1218. Absorption Spectrum, Molecular Volume and Refraction of Certain Rare-Earth Salts. P. W. Selwood. *Am. Chem. Soc., J.* 52. *pp.* 4308–4316, *Nov.*, 1930.—The molecular refraction of neodymium nitrate increases slightly with concentration, while that of the chloride decreases. The molecular volume of both salts increases. The absorption bands move towards the red with increasing concentration, and more so in the crystal. The bands of praseodymium and samarium nitrates are also shifted towards the red, while those of europium and gadolinium are hardly affected, and those of holmium and erbium are noticeably moved towards the blue. [See Abstract 457 (1931).] C. B. A.

1219. Absorption Spectrum of Methane. D. M. Dennison and S. B. Ingram. *Phys. Rev.* 36. *pp.* 1451–1459, *Nov.* 1, 1930.—The absorption spectrum of methane from 6500 Å. to 9500 Å. has been examined with a large concave grating. A path length of 10 m. of gas at a pressure of 70 cm. was used. A band at 8900 Å. has been identified as the third overtone of the fundamental absorption band at 3·3 μ. The fine structure is very complex and irregular, consisting of over 100 lines, of which about five are very intense. The theory of overtones of such molecules is examined, and while the degree of complexity is explained it has not been possible to give a detailed analysis of the lines. F. S.

1220. Analysis of the Ultra-Violet HCl Bands. M. Kulp. *Phys. Zeits.* 31. *pp.* 959–960; *Disc.*, 960, *Nov.* 1, 1930. *Zeits. f. Physik,* 67. 1–2. *pp.* 7–23, *Jan.* 12, 1931. *Paper read before the Deut. Physikertag., Königsberg, Sept.*, 1930.—The bands between 3000 Å. and 4000 Å. were freshly observed and analysed. They consist of six branches, which are arbitrarily designated as P, P′, Q, Q′, R R′. There are the same differences between the lines of branches R and Q as between Q′ and P′ and the same between R′ and Q′ as between Q and P. The bands are arranged in the spectrum in pairs, and this makes it probable that the system is one of doublets, and that the bands are due to HCl^+ and not to HCl. It appears that $^2\Sigma \rightarrow {}^2\Pi$ interchanges are involved. For the higher term $^2\Sigma$ the component of the total impulse of the electronic orbits Λ is zero, and there is only the reciprocal action between spin and rotation. For the lower term $^2\Pi$ $\Lambda = 1$. The reciprocal action between Λ and the spin is strong, and we have approximately Hund's *a* coupling. This gives for parallel and antiparallel spin the terms $\Pi_{+\frac{1}{2}}$ and $\Pi_{-\frac{1}{2}}$. A diagram is given showing the relations between the two sets of terms and the branches P, P′, Q, Q′, R, R′, and the author explains by this means a number of properties of the spectrum. In the *Discussion*, **Weizel** called attention to the relation between the HCl^+ spectrum and the theoretically very important OH spectrum. H. N. A.

1221. Absorption of Aqueous Solutions of Hydrochloric Acid in the Ultra-Violet. R. Tréhin. *Comptes Rendus*, 191. *pp*. 774–776, *Nov*. 3, 1930.—Solutions of very great purity have been employed, and the absorption has been studied between 2816 and 1990 Å. for concentrations between 0·5 and 13 moles per litre, with layers from 10 to 20 mm. thick. Above 2320 Å. the absorption increases regularly with the concentration. Below 2320 Å. the absorption increases at first with the concentration, and shows a maximum for a certain concentration; the maximum diminishes as one advances in the ultra-violet. For each concentration, with a given thickness, the absorption increases regularly when the wave-length diminishes. The above shows that Beer's law does not apply. It is clear that the nature of the absorbing particles becomes modified in concentrated solutions. H. N. A.

1222. Spectrum of Hydrobromic Acid. W. Weizel, H. W. Wolff and H. E. Binkele. *Zeits. f. phys. Chem*. 10. *Abt. B*. 6. *pp*. 459–466, *Nov*., 1930.—The spectrum was excited in a discharge tube and photographed with glass, quartz and grating spectrographs. It shows a continuous spectrum from the green which decreases in intensity towards shorter waves, and disappears about 2500 Å. There is a flat maximum in the near ultra-violet. The continuous spectrum is taken to be the dissociation spectrum of either HBr or HBr^+. F. S.

1223. Modifications in the Absorption Spectrum Curve of a Solution of Colouring Matter by the Introduction of a Colloid. A. Boutaric and M. Doladilhe. *Comptes Rendus*, 191. *pp*. 1008–1010, *Nov*. 24, 1930.—Introduction of a colloid into a solution of a colouring matter existing in the molecular state produces no change in the absorption spectrum. With a colloidal colouring matter, however, addition of an unstable, suspensoid or lyophobe colloid with granules of opposite sign to those of the colouring matter causes diminution in the opacity of the colouring matter, the ordinates of the absorption spectrum curve being reduced in the same proportion throughout the whole length of the spectrum. With a similar colloid but with granules of the same sign as those of the colouring matter, the reduction in opacity is virtually zero. If the colloid introduced is stable, emulsoid or lyophile in character, the opacity is diminished as above, the extent of the reduction depending on the H-ion concentration of the colloid added and increasing regularly as the variation in pH tends to give a colloidal ion of contrary sign to that of the colouring matter. These results furnish a simple method of determining whether a colouring matter is or is not colloidal, two hydrosols with granules of opposite signs, such as those of arsenic sulphide and ferric hydroxide, being added in small amounts to the solution of the colouring matter. T. H. P.

1224. Molecular Terms of Hydrogen with Two Excited Electrons. W. Weizel. *Zeits. f. Physik*, 65. 7–8. *pp*. 456–463, 1930.—It is shown that two terms, X and 3^1K in the hydrogen molecular spectrum, corresponding to one excited electron, cannot be identified with any theoretical terms. Instead of these the new interpretation $X \equiv (2p\sigma)^2\,{}'\Sigma$ and $K \equiv 2p\sigma 3p\sigma\,{}'\Sigma$ is given corresponding to two excited electrons. An estimate of the term energy gives values for the X terms which can be identified with the energy levels of the X terms, and gives a stable configuration. The interpretation is also in conformity with the magnitude of the nuclear separation. J. E.

1225. Shift of Hydrogen Terms in High Electric Fields. C. Lanczos. *Zeits. f. Physik*, 65. 7–8. *pp*. 431–455, 1930.—The method of direct asymptotic treatment of the wave-function for the Stark effect is improved if the eigenvalues are considered in the same way. Instead of a series for the Stark displacement, which becomes divergent for high fields, there is obtained a definite formula in terms of elliptic normal integrals, which can be evaluated. A comparison of the three-term formula so obtained with the series expression in the region of high fields indicates that it does not really express the mechanism, but that the terms neglected compensate out. [See also Abstract 3735 (1930).] J. E.

1226. Relativity Separation of Spectral Lines of Atoms of the Hydrogen Type in Parallel and Crossed Electric and Magnetic Fields. D. P. R. Chaudhuri. *Zeits. f. Physik*, 65. 11–12. *pp*. 824–829, 1930.—The effect of parallel or crossed electric and magnetic fields upon the separation of lines in the spectra of hydrogen-like atoms is deduced mathematically for the case of relatively weak fields, taking into account the relativity term. The case of strong fields permitting omission of the relativity term has been previously discussed by Sen [see Abstract 609 (1930)]. J. S. G. T.

1227. Effect of Non-Homogeneous Electric Field on the Fine Structure of Hydrogen-Like Atoms. S. Gupta. *Zeits. f. Physik*, 66. 3–4. *pp*. 246–256, 1930.—The two-component wave equation given by Darwin is used to derive the non-homogeneous Stark effect for hydrogen-like atoms, the potential energy function being taken as $V = Ne/r + a(x^2 + y^2 - 2z^2)$. Here a equals the gradient of the Stark field which has zero intensity at the centre of the atom, and is taken as axial symmetric. For the first and second quantum states of the atom, all the fine structure levels except the lowest one, split into several components, whose distances apart vary as the first power of the field gradient a, the separations of the components of the lowest level varying as a^2. The separation of the components decreases with increase of atomic number. Frequencies and intensities of the components into which the fine structure levels of H_α split up are tabulated. For a field gradient $a = 10^6$ the separations are so small, of the order 10^{-3} Å., that only a broadening of the lines is to be expected. W. S. S.

1228. Excitation Functions in the Neon Spectrum. W. Hanle. *Zeits. f. Physik*, 65. 7–8. *pp.* 512–516, 1930.—Measurements are given of the excitation functions of some of the neon lines situated in the red and yellow regions of the spectrum. The strong dependence on pressure of the intensity distribution in the neon spectrum is discussed. J. J. S.

1229. Effect of Slit Width upon Distribution of Intensity in Spectral Lines. P. H. van Cittert. *Zeits. f. Physik*, 65. 7–8. *pp.* 547–563, 1930.—A mathematical analysis shows that the broadening of spectral lines associated with an increase of slit width is dependent both upon the type of illumination falling upon the slit and upon the angular divergence of the light entering the collinator. There are two limiting cases considered, *viz.*, those in which the divergence of the beam is respectively (1) very large, and (2) very small. In the latter case the lines are considerably narrower. A definite slit width which should not be exceeded corresponds to each angular divergence of the beam. J. S. G. T.

1230. Validity of the Hill and van Vleck Intensity Formulæ for the NOγ Bands. R. Schmid, T. v. Neugebauer, D. v. Farkas and Charlotte Barabas. *Zeits. f. Physik*, 65. 7–8. *pp.* 541–547, 1930.—Shows that the intensity formulæ developed by Hill and van Vleck [see Abstract 58 (1929)] accurately express the observed intensity series for the $^2\Sigma_{(b)} \rightarrow {}^2\Pi_{(x)}$ transitions occurring in the parts of the NOγ bands. R. C. F.

1231. Intensity and Sum Rules in Normal Quadripole Multiplets. A. Rubinowicz. *Zeits. f. Physik*, 65. 9–10. *pp.* 662–676, 1930.—It is deduced from a " Laporte rule for quadripole radiation " that dipole and quadripole multiplets are invariably separated. The relative transition probabilities in a normal quadripole multiplet are determined, and by the aid of these the existence of sum rules for such multiplets is demonstrated. Comparisons with experimental intensity ratios for quadripole multiplets in a number of cases show satisfactory agreement. W. S. S.

1232. Quantitative Spectro-Analysis. H. Lundegårdh. *Zeits. f. Physik*, 66. 1–2. *pp.* 109–118, 1930.—The quantitative determination of substances in solution by measurement of the intensity of the appropriate spectral lines emitted when a spray of the solution is injected into an acetylene flame is facilitated by the use of a photoelectric cell in conjunction with a thermionic valve amplifier and a galvanometer. The anode current resulting from the photoelectric cell effect is adjusted by means of a compensating battery and variable resistance in order to obtain maximum sensitivity. For potassium at concentrations from 0·001M to 0·025M and calcium at concentrations from 0·00025M to 0·004M the galvanometer deflection is a linear function of the concentration. Iron and sodium may be determined at concentrations down to 0·005M and 0·0000625M respectively, but the linear relationship does not hold for these metals. A method is described also for the determination of minute quantities of gases, and especially of carbon dioxide, by measurement of the intensity of the spectral lines which are emitted when the gas is allowed to flow between platinum or gold spark electrodes. H. F. G.

1233. Raman Effect in Acetylene. E. Segrè. *Accad. Lincei, Atti*, 12. 5–6. *pp.* 226–228, *Sept.*, 1930.—There are extremely few results available for the Raman effect in gases. An apparatus is described in this paper suitable for studying the effect in the visible, although it is pointed out that, where possible, measurements in the ultra-violet would be still more useful. The source is a quartz mercury-vapour lamp, and the acetylene is contained in a large Pyrex vessel. In photographing the spectrum, exposures from 36 to 72 hours were given. Six Raman lines were observed, of which only one was diffuse. The five sharp lines correspond to a frequency difference of 1979 ± 6 cm.$^{-1}$, compared with the value 1960 found by Daure for acetylene dissolved in acetone. It is stated, on the authority of R. Mecke, that the frequency 1979 has been found in the infra-red absorption spectrum, and is one of the fundamental frequencies of oscillation of the acetylene molecule. J. H. A.

1234. Intensities of Raman Lines. L. S. Ornstein and J. Rekveld. *Zeits. f. Physik*, 65. 11–12. *pp.* 719–722, 1930.—Criticises a paper by Sirkar [see Abstract 158 (1931)] in which he reaches conclusions differing from those of the authors [see Abstract 3146 (1930)], and ascribes the lack of agreement to their neglect to allow for absorption. The authors show by calculation and by direct experiment that the absorption is negligible. A. C. M.

1235. Polarisation of Raman Lines in Crystals. C. Schaefer, F. Matossi and H. Aderhold. *Zeits. f. Physik*, 65. 5–6. *pp.* 319–329, 1930.—The dependence of the polarisation of Raman lines on the orientation of the scattering crystal is investigated for calcite, sodium nitrate and gypsum. The theoretical treatment of Leontowitsch [see Abstract 3144 (1930)] is found not to fit the observations. The discrepancies are believed not to be due to any fault in the theory, but to the assumptions made by Leontowitsch with regard to the symmetry of the electric tensors. Matossi works the other way round, and uses the present results to deduce what the nature of the electric tensors must be. In this way he shows that the CO_3 ion is an isosceles triangle [see Abstract 496 (1931)]. The sodium nitrate and calcite results were similar for corresponding lines. The water lines in gypsum showed themselves strongly polarised and in directions dependent on the orientation of the crystal, but the SO_4 lines did not differ greatly in intensity as the crystal was orientated. A. C. M.

1236. Intensities of Raman Lines. S. C. Sirkar. *Indian Journ. Phys.* 5. 6. *pp.* 593–601, *and* 663–668, *Oct.*, 1930.—The ratio is determined of the absolute intensities of the displaced lines relative to those of the exciting lines. This ratio is found for cyclohexane (2853 and 800 cm^{-1} shifts) and benzene (3080 and 990). The intensities of the Raman lines excited by ultra-violet lines are greater than would be indicated by the fourth power law relative to the visible lines. Raman lines corresponding to greater frequency shifts deviate more from the fourth power law than do those corresponding to lesser shifts; *e.g.*, 2853 (cyclohexane) deviates by 216 % from the law, while 800 deviates by 63 %. In the second paper a similar investigation is carried out for nitrobenzene (shifts 1342 and 1582 cm.$^{-1}$). These two lines are close together, and therefore readily compared; nitrobenzene has an absorption in the visible, and consequently the effect of absorption can be investigated. The relative intensities of the two lines can easily be compared when scattered by different exciting lines, and thus it can be seen whether both lines obey the same law. They did not. A. C. M.

1237. Polarisation of Raman Lines in Hydrocarbons. S. Bhagavantam. *Indian Journ. Phys.* 5. 6. *pp.* 603–608, *Oct.*, 1930.—Benzene, cyclohexane and pentane are investigated. Lines corresponding to shifts 992 cm.$^{-1}$ in benzene and 800 and 992 in cyclohexane are almost completely polarised. It is suggested that this means that these vibrations correspond to inactive vibrations, which is borne out by the fact that these vibrations do not appear strongly in infra-red absorption curves. The characteristic hydrogen vibrations differ greatly among themselves with regard to polarisation, but the more intense components are usually the better polarised. Benzene has several lines which show no polarisation at all. A. C. M.

1238. Raman Spectrum of Diamond. S. Bhagavantam. *Indian Journ. Phys.* 5. 6. *pp.* 573–586, *Oct.*, 1930.—An exceptionally clear stone of 20 carats gives feeble lines 1158, 1288, 1382, 1431, 1480 and 1585 cm.$^{-1}$ in addition to the strong 1332 previously reported [see Abstract 158 (1931)]. Some of these have counterparts in the infra-red. 1332 is believed to be optically inactive in perfect diamonds, but distortion in some crystals may result in this being rendered active. The results are discussed in relation to specific heat data. A. C. M.

1239. Raman Spectra of Inorganic Crystals. Parts I and II. P. Krishnamurti. *Indian Journ. Phys.* 5. 6. *pp.* 633–662, *Oct.*, 1930.—Part I refers to substances containing XO_3 and XO_4 groups. The substances investigated (by the powder method) are (XO_3) chlorates of sodium, potassium and barium, bromates of sodium and potassium, and potassium iodate and iodic acid; and (XO_4) perchlorates of sodium and ammonium, potassium periodate, ammonium molybdate and sodium tungstate. In the chlorates all the observed frequencies are active ones, since corresponding infra-red maxima are known. This is taken as evidence that the chlorate group is not triangular, but that the chlorine atom is out of the plane of the oxygen atoms. The strong line in the chlorates lessens in frequency in going to bromates and iodates, and also splits. Part II. Hydroxides of sodium, strontium and barium, sodium cyanide, potassium-silver cyanide (solution), mercuric cyanide, potassium ferrocyanide, and thiocyanates of potassium, ammonium, barium all gave lines. NaOH gave a very strong, sharp line attributable to the OH group. The CN frequency is raised by covalent bands between the CN group and other groups. The SCN group is pictured as $S{=}C{=}N$. A. C. M.

1240. Raman Spectra of Certain Isomers. H. Mlodzianowska. *Zeits. f. Physik,* 65. 1–2. *pp.* 124–129, 1930.—The Raman spectra are shown to be all different for three types of isomeric compounds (o-, m-, p-dichlorbenzene, o-, m-, p-nitrotoluene, and o-, m-, p-toluidine). Certain lines occurred in all three forms, o-, m-, p. Other lines appeared in two, say in o- and m-, or in m- and p-, or in p- and o-, and yet other lines appeared in one of the three only. The first class of lines must be those which are connected with vibrations independent of the position of the group in the molecule; the second class must depend on certain arrangements which are similarly placed in two of the three possible arrangements, and the third class must depend on the exact arrangement. A. C. M.

1241. Raman Effect. A Simple Molecular Model. M. Radaković. *Akad. Wiss. Wien, Ber.* 139. 2*a*. 3–4. *pp.* 107–121, 1930.—The normal modes of vibration are investigated for a system of three

point masses, held together by forces which are null when the masses are in their rest positions. The general case is considered, but since only vibrations are of interest, the c.g. is considered fixed. The equations of motion are then developed, and three equations involving the frequencies of the three normal vibrations are deduced, which involve the three angles of the triangle, the three masses, and the binding forces between the masses taken two at a time. The results are too detailed for abstraction.
A. C. M.

1242. Raman Effect in Organic Substances. A. Dadieu and K. W. F. Kohlrausch. *Akad. Wiss. Wien, Ber.* 139. 2*a*. 3–4. *pp*. 165–180, *and* 7–8. *pp*. 459–472, 1930.—The substances whose Raman spectra are newly reported by the authors are propionitrile, benzylnitrile, methylene bromide, methylene iodide and dimethylamine. The Raman spectra of various organic substances are considered, and fit in with the idea that some of them represent normal modes of vibration of point-mass systems, the point-masses being either atoms or groups of atoms, and that the others are " inner " vibrations of the atoms forming groups. Calculations made on some examples of the types $X—CH_3$, $X—CH_2—X$ and CHX_3 show that the restoring forces per unit displacement and angles between the valency directions are of the expected order. The Raman spectra are described, of propylamine, ethylene diamine, aniline, formamide, diethylamine, diphenylamine, trimethylamine, triethylamine, dicyandiamide and methylnitramine. A table is given of the Raman spectra of 16 amines. Corrections are also given to a few previous observations.
A. C. M.

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1243. Improved Technique for the Raman Effect. R. W. Wood. *Phys. Rev.* 36. *pp*. 1421–1430, *Nov*. 1, 1930.—The unfiltered light from a mercury arc is not well suited for an analysis of Raman spectra. The confusion of interpretation which may result is illustrated in the case of benzene. The object of a filter is two-fold: the limitation of the excitation to light of a single wave-length (if possible), and the suppression of the continuous spectrum in the region in which the Raman spectrum appears. Raman spectra of benzene excited by the mercury arc through various filters are reproduced. Suggestions concerning the proper design and manipulation of arc, filter tubes and scattering tubes are given. The use of the General Electric Company's hot-kathode helium arc as a source for Raman spectra excitation is described. The Raman spectrum of benzene excited by this source through a nickel-oxide glass filter is reproduced.
AUTHOR.

1244. Raman Spectra of Benzene and Diphenyl. R. W. Wood. *Phys. Rev.* 36. *pp*. 1431–1434, *Nov*. 1, 1930.—Raman spectrum of benzene.—By employing suitable filters with both mercury-arc and helium-arc excitation a number of new lines have been recorded. The complete spectrum given in frequency differences, $\Delta\nu$, is as follows: $\Delta\nu$ = 606, 849, 992, 1178, 1584, 1603, 2460, 2542, 2597, 2617, 2784, 2928, 2947, 3046, 3060, 3164. Anti-Stokes lines corresponding to $\Delta\nu$ values 606, 849, 992 are verified. Raman spectrum of diphenyl.—With mercury-arc excitation and quinine sulphate filter fair spectra were obtained though the continuous background due to fluorescence was troublesome. The spectrum consisted of five faint diffuse lines and seven strong lines. Their $\Delta\nu$ values are: 416, 606, 731, 766, 810 (these are very faint) and 990, 1023, 1280, 1544, 1584, 1603, 3055, 3170. It will be noted that six of the lines are found in the spectrum of benzene. AUTHOR.

1245. Raman Effect in Monohalogen Methane Derivatives. G. N. Ball. *Zeits. f. Physik*, 66. 3–4. *pp*. 257–260, 1930.—The rotation-vibration spectra of CH_3F, CH_3Cl, CH_3Br and CH_3I have been measured by Bennett and Meyer [see Abstract 1208 (1929)]. Certain of the bands expected lay outside the region which was investigated. The author has investigated CH_3Cl, CH_3Br and CH_3I, scattering light from a Heræus quartz mercury-vapour lamp by the liquids, and finds, in addition to other lines, two of the missing bands. A. C. M.

1246. Raman Effect in N_2O. J. C. McLennan, H. D. Smith and J. O. Wilhelm. *Roy. Soc. Canada, Trans.* 24. *Sect.* 3. *pp*. 197–205, *May*, 1930.—The Raman spectrum of liquid N_2O is determined, and the results are compared with those obtained by Dickinson, Dillon and Rasetti for gaseous N_2O [see Abstract 600 (1930)]. The liquid was contained in a vertical four-walled Dewar tube arrangement, so that liquid air would be employed as a refrigerant. Lines having shifts 1281 and 2223 cm^{-1} were recorded. 1281 is allocated to the inactive fundamental vibration of the molecule, considered linear. 2223 is allocated to the asymmetrical vibration in the line of the molecule. In the gaseous state, Dickinson, Dillon and Rasetti found 1281·8 cm^{-1} agreeing well with the result here obtained for the liquid. A. C. M.

1247. Raman Spectrum of NO. F. Rasetti. *Zeits. f. Physik*, 66. 9–10. *pp*. 646–649, 1930.—Light scattered in NO contained in a glass tube under 3–4 atmospheres pressure was photographed with an E315 (Hilger) spectrograph and the plate micro-photometered. The transition $^2\Pi_{\frac{1}{2}} \rightarrow {}^2\Pi_{\frac{3}{2}}$ is clearly present, both Stokes and anti-Stokes lines appearing. The shift is 122 cm^{-1}. The theoretically expected shift is 122·7 cm^{-1}. The rotation-spectrum is also partly represented by small fluctuations of intensity, particularly on the red side of the exciting line. The structure of the rotation-spectrum is in agreement with that theoretically expected. [For earlier work on NO, see Abstracts 200 and 3145 (1930).] A. C. M.

1248. Raman Effect and Molecular Constitution. Part III. B. Trumpy. *Zeits. f. Physik*, 66. 11–12. *pp*. 790–806, 1930.—The molecules first considered are those of CCl_4, $SiCl_4$, $TiCl_4$ and $SnCl_4$. These are tetrahedral, and possess four normal modes of vibration, and four Raman frequencies. The modes of vibration are allocated to the frequencies by a graphical method, and the binding forces thus deduced and compared. A reasonable alteration of the binding forces occurs as the central atom is altered. $SnBr_4$ is next investigated, to find the effect of altering the outside atoms. The heavier Br atoms lead to slower vibrations. Lastly, mixtures of $SnCl_4$ and $SnBr_4$ are investigated, and it is shown that there are present intermediate compounds $SnClBr_3$, $SnCl_2Br_2$ and $SnCl_3Br$, in addition to the original $SnCl_4$ and $SnBr_4$. [For the apparatus and method used, see Abstracts 3436 (1930) and 497 (1931).] [A. C. M.

1249. Raman Effect Apparatus. L. J. Buttolph. *Rev. Sci. Instruments*, 1. *pp*. 650–653, *Nov*., 1930.—Describes an apparatus for the observation of the Raman effect in liquids, using standard tubular light sources and an elliptical mirror surrounding the source and tube to concentrate the light. [See also Abstract 4020 (1930).] A. C. M.

1250. Interferometer Measurements in the Infra-Red Region of Xenon and Iron. J. C. McLennan and Florence M. Quinlan. *Roy. Soc. Canada, Trans.* 24. *Sect.* 3. *pp.* 47–52, *May,* 1930.—The research was undertaken to find suitable wave-length standards for iron and neon above 6678 Å. and 7536 Å. respectively. Twelve xenon lines from $\lambda = 8952$ to $\lambda = 6827$ were measured, but they are all unsuitable for standards, since the values altered as much as 0·03 Å. in three days, as the discharge tube became aged. For iron, it is recommended that the standard Pfund arc should be used. Twenty-one lines were measured with an accuracy from 1 to 3 thousandths of an Ångstrom, and five of these, classified as A, are thought to be most suitable for use as standards between 6678 Å. and 8388 Å. J. H. A.

1251. Interference Measurements in the First Spectra of Krypton and Xenon. C. J. Humphreys. *Bureau of Standards, J. of Research,* 5. *pp.* 1041–1057, *Nov.,* 1930.—Accurate relative values of all the $1s$, $2p$ and $3p$ terms of the krypton spectrum have been established on the basis of new determinations of the stronger arc lines made with the Fabry-Pérot interferometer; the average deviation of the calculated term combinations from the observed wave numbers is 1 in 20×10^6. In the xenon spectrum all the $1s$, $2p$ (except $2p_{10}$), and $3p$ terms, and four of the $4p$ terms have been recalculated. Nearly 75 % of the combinations allowed by the selection principle have been observed. Calculated values of the infra-red combinations which are not photographically accessible are proposed as wave-length standards in this region. None of the krypton lines exhibit fine structure under the resolving power employed, and the intensities of any satellites which may exist are too small to influence the wave-lengths; five of the xenon lines exhibit satellites. Under conditions required to excite the spark spectra a change of wave-length of the krypton and xenon arc lines has been observed, and is ascribed to the Stark effect. McLennan and Quinlan's "pressure effect" appears to be due to experimental error. H. F. G.

1252. Theory of Complex Spectra. E. U. Condon. *Phys. Rev.* 36. *pp.* 1121–1133, *Oct.* 1, 1930.—Extending the paper of Slater [see Abstract 1452 (1930)] on complex spectra, it is pointed out that assignment of definite electron configurations to spectral terms is an approximate procedure and only has meaning when the multiplet systems of the several configurations are widely separated. The effect of including spin terms is sketched. Non-diagonal matrix elements for the N-electron problem are reduced to corresponding elements for the 2-electron problem, as Slater did for the diagonal elements. Two-electron jumps occur because of the fact that spectral terms may not be precisely labelled by means of electron configurations. AUTHOR.

1253. Temperature Classification of the Spectra of Europium, Gadolinium, Terbium, Dysprosium, and Holmium, $\lambda 3850$ to $\lambda 4700$. A. S. King. *Mt. Wilson Observat. Contrib. No.* 368. *Astrophys. J.* 72. *pp.* 221–255, *Nov.,* 1930.—Spectra of europium, gadolinium, terbium, dysprosium and holmium, as given by electric furnace, arc and spark, have been examined in the range $\lambda 3850$ to $\lambda 4700$ with regard to the segregation of neutral and enhanced lines, temperature classification, the occurrence of hyperfine structure, and other distinctive features. The total of 2277 lines listed is made up of 219 lines of europium, 627 of gadolinium, 733 of terbium, 534 of dysprosium and 164 of holmium. Measurements of wave-length were made for 666 lines. These are in part new lines prominent in the furnace but faint in the arc spectrum, partly known lines for which improved measurements could be obtained, and partly close doublets previously measured as single lines. The spectra of gadolinium, terbium and dysprosium are especially rich in neutral lines which are relatively strong in the furnace. Europium and dysprosium show low-temperature lines which have high intensity and are easily reversible, a type which is unusual in the spectra of the rare earths. Lines having hyperfine structure are numerous in the spectra of europium, terbium and holmium. The patterns of hyperfine holmium lines resemble those of praseodymium. The present material, taken in connection with data at hand for other rare earths, shows that hyperfine structure occurs regularly in the spectra of rare earths of odd atomic number, as far as their spectra have been observed with reference to this phenomenon, while for even numbered rare earths the spectrum lines are uniformly without hyperfine structure. [See also Abstract 1194 (1929).] AUTHOR.

1254. Influence of Pressure and Temperature on the Absorption of Excited Mercury Vapour. O. Masaki. *Zeits. f. Physik*, 66. 3–4. *pp.* 229–240, 1930.—The effect of the pressure and temperature on additions of neon to excited mercury vapour is studied in relation to the absorption of the $2^3P_{0,1,2}$—2^3S_1 transferences. While the absorption of 4047 Å. and 5461 Å. slightly decreases with increasing pressure, 4358 Å. shows a small increase. The absorption of 4358 Å. increases rapidly with temperature and reaches a saturation value, 4047 Å. increases slowly to the same value, and 5461 Å. shows a slight decrease of absorption and attains a somewhat lower saturation value than the other lines. F. S.

1255. Photoelectric Measurements of Intensity in the Mercury Spectrum. Part. II. L. S. Ornstein and J. F. Custers. *K. Akad. Amsterdam Proc*, 33. 8. *pp.* 809–813, 1930. *In German.*—Certain difficulties in the interpretation of the results obtained in Part I [see Abstract 3725 (1930)] have been cleared up by means of a series of additional measurements, in which the connection between the voltage on the discharge tube, which varied from some 20 volts up to about 470 volts, the pressure, which varied from 1·85 mm. to 0·00293 mm., and the current, which varied from 0·02 mA up to 150 mA were made evident. The curves showing the relation between voltage and the logarithm of the current all show a maximum value of the voltage for some definite current. The position of the maximum voltage shifts towards larger current values as the pressure increases. The value of the maximum falls at first as the pressure diminishes, but rises again for very small pressures. The fact that the ratio I/i of the intensity of a line to the current increases with falling values of i is ascribed to the excitation function of the state in question, and it is possible to deduce from the V,i curve system that this phenomenon is to be expected at every pressure. Curves illustrating this are given, showing the relation between I and i and between I/i and i for different wave-lengths and pressures. H. N. A.

1256. Intensity Anomalies in Silver and Gold Multiplets. S. Sambursky. *K. Akad. Amsterdam, Proc.* 33. 9. *pp.* 1025–1027, 1930. *In German.*—Briefly describes certain intensity anomalies which occur in silver and gold multiplets the structures of which resemble those for the alkalis previously examined [see Abstract 2726 (1928)]. The intensity ratio of the second doublet of the principal silver series is 2·4 to 1 instead of the normal 2 to 1 ratio, and even this value is apparently too small. This value can be used for the proof of Fermi's theory. The intensity ratio of gold lines 4241·8 Å. and 3650·7 Å. is found to be the normal ratio, but lines of the diffuse near series ($2^2P—3^2D$) show marked deviations from the expected intensity ratio 1: 9: 5. A mean value of 1 : 13·5 is obtained instead of 1 : 9, the ratio, however, being dependent upon the arc current. This anomaly must be due to a destruction of the 3^2D term, which is also shown to be true for silver. R. C. F.

1257. Spectral Distribution of Energy Radiated from a New Type of Tungsten Mercury Arc. B. T. Barnes. *Phys. Rev.* 36. *pp.* 1468–1474, *Nov.* 1, 1930.—This paper describes measurements with a quartz monochromator and thermopile of the energy flux from the tungsten mercury arc which is the source of radiation in the General Electric Sunlamp. Data are given on the energy flux radiated in each of the principal mercury lines below 6000 Å., and a curve is given for the distribution of energy in the continuous spectrum between 2500 Å. and 17,000 Å. The maximum in the continuous spectrum curve comes at about 10,600 Å. where the energy flux in a 50 Å. band is $6·5_9$ microwatts per cm.^{2} at 1 m. distance from the centre of the arc in a direction normal to the plane of the leads when the arc is operated with 115 volts on the primary of the transformer. The energy maximum corresponds to that of tungsten at about 2500° K., but the shape of the curve below 5000 Å. corresponds more closely to that of tungsten at 3250° K., which is approximately the maximum temperature of the electrodes. For the radiation in a direction normal to the plane of the leads, 1 % of the total energy flux was found to lie between 2500 and 3200 Å., 1 % between 3200 and 4000 Å., 10 % between 4000 Å. and 7600 Å., 46 % between 7600 and 17,000 Å., $29·_5$ % between 17,000 Å. and the cut-off (roughly 40,000 Å.) of a fused quartz plate 2·4 mm. thick and the remaining $12·_5$ % at longer wave-lengths. AUTHOR.

1258. General Electric Type S-1 Lamp as a Spectroscopic Source. D. Dooley. *Phys. Rev.* 36. *pp.* 1476–1479, *Nov.* 1, 1930.—The possibilities presented by the General Electric type S-1 lamp as a spectroscopic source have been investigated by employing lamps filled with argon, hydrogen, helium, neon and carbon dioxide. Nitrogen-filled lamps yielded the second positive bands of nitrogen greatly modified in form from that usually obtained from a Geissler tube discharge. The spectra of hydrogen-filled lamps which also contained mercury showed the mercury hydride bands, while the spectra of carbon dioxide-filled lamps gave evidence only of the third positive bands of Deslandres. Further investigation of the more quantitative aspects of the problem will be made. AUTHOR.

1259. Correction and Extension of the Series of the Silver Arc Spectrum, AgI. H. A. Blair. *Phys. Rev.* 36. *pp.* 1531–1534, *Nov.* 15, 1930.—Measurements, with a Schüler-tube source and helium standards, of the high series members of AgI showed the older measurements to be rather poor. A few new lines have been added. No terms of the quartet system nor of the $d^9s^2\ {}^2D$ were found from new arc measurements. The $d^{10}5s\ {}^2S$ is at 61104·4, which gives an ionising potential of 7·53 volts. AUTHOR.

1260. Effect of Gases on the Optically-Excited Cadmium I Spectrum. P. Bender. *Phys. Rev.* 36. *pp.* 1535–1542, *Nov.* 15, 1930.—An apparatus producing intense optically excited cadmium radiation is used to study the effects of nitrogen, carbon monoxide and hydrogen on the optically excited cadmium spectrum, which effects are compared to similar phenomena with mercury. Each gas produces a decrease in the intensity of each of the spectral lines; no increase occurs because of the lack of self-reversal in the lines of the exciting source. The quenching of the resonance line 3261 Å. is less than that of the remainder of the spectrum. Nitrogen quenches very efficiently, while carbon monoxide is considerably more efficient: about 35 mm. and 3 mm., respectively, of gas pressure are necessary to reduce the intensity of the resonance line to half value. Both of these gases transfer the excited cadmium atom from the 2^3P_1 to the metastable 2^3P_0 state by kinetic energy collisions. Hydrogen quenches the cadmium radiation very effectively; a collision between the excited 2^3P_1 cadmium atom and a hydrogen molecule produces a normal cadmium hydride molecule and a hydrogen atom. AUTHOR.

1261. Optical Excitation of Cadmium Hydride and Zinc Hydride Bands. P. Bender. *Phys. Rev.* 36. *pp.* 1543–1552, *Nov.* 15, 1930.—Excitation of a cadmium-hydrogen gas mixture with light from a hydrogen-cadmium electric discharge produces with great intensity a portion of the band system of the CdH molecule, while excitation of the same mixture with light from a helium-cadmium discharge does not produce these bands. The process consists, first, of a collision between a 2^3P_1 cadmium atom and a H_2 molecule to form an unexcited CdH molecule, which molecule is then brought to the excited levels by absorption from the exciting light of the band frequencies themselves, whence it emits the band radiation in returning to the normal state. A weak excitation of the entire $^2\Pi$—$^2\Sigma$ band system also occurs independently of the optical excitation as a result of collisions of the second kind with excited cadmium atoms. ZnH bands are also produced as a true optical resonance phenomenon under exactly parallel conditions. The formation of the ZnH molecule results in a selective quenching by hydrogen of the triplet zinc spectrum, while the singlet spectrum is unaffected. The experiment of Gaviola and Wood, in which HgH bands are excited through collisions of the second kind, is repeated and discussed in the light of the above results. AUTHOR.

1262. Isotope Effect on Band Spectrum Intensities. J. L. Dunham. *Phys. Rev.* 36. *pp.* 1553–1559, *Nov.* 15, 1930.—It is shown that there is no change in the electronic part of the transition probability with nuclear mass, and that the vibrational part is the only part that does show an effect. This effect is calculated on the basis of Hutchisson's expressions for the vibrational transition probability. The effect of a change in nuclear mass on the population of the initial state is also found if this population is given by the simple Boltzmann distribution. The magnitude of the isotope effect is found for certain bands of O_2, NO and Cl_2, which have been used recently to measure the abundance of the isotopes of these substances by means of their band spectra. The effect is small, being ordinarily less than 10 %, but it cannot generally be neglected. AUTHOR.

1263. Theoretical Values of the Fundamental Oscillation Quantum of Certain Gaseous Alkali Iodides. H. J. van Leeuwen. *Zeits. f. Physik*, 66. 3–4. *pp.* 241–245, 1930.—For an alkali halide in which the kation is small compared with the anion, the equilibrium distance apart and the fundamental oscillation frequency are determinable to a first approximation by solving the wave-mechanics problem of the perturbation of the electrons forming the outer shell of the anion, produced by a single point-charge positive. The calculation is carried out assuming the outer shell to be the O level (corresponding to iodine) and numerical computations of the fundamental oscillation quant $\left(\frac{1}{\lambda}\right)$ are made for LiI, NaI, KI and RbI. Comparisons between computed and experimental values are given in a table as follows:

$\frac{1}{\lambda}$ in cm^{-1}.	LiI.	NaI.	KI.	RbI.
Computed	509	265	187	136
Observed	—	279	246	179

Agreement is good for NaI and less good for KI and RbI where the kation is larger and for which the assumptions of the theory are not so satisfactory.
W. S. S.

1264. Term System and Visible and Near Ultra-Violet Lines in the Carbon Spectrum, CIV. B. Edlén and J. Stenman. *Zeits. f. Physik*, 66. 5–6. *pp.* 328–338, 1930.—The spectrum of the vacuum spark between graphite electrodes has been studied with a quartz spectrograph. Among other lines strong lines corresponding to transitions between four and five and between six and seven quantum states have been identified for CIV. From these lines and the ground lines in the extreme ultraviolet all the terms with total quantum number up to six have been exactly evaluated and the term 6H has been found to be a hydrogen-like term. The splitting for 2^2P, 3^2P and 4^2P follows the Landé rule. J. E.

1265. Nuclear Moments of Li^6 and Li^7. H. Schüler. *Zeits. f. Physik*, 66. 7–8. *pp.* 431–435, 1930.—The question whether the nuclear moment $i = \frac{1}{2}$ or that $i = \frac{3}{2}$ is concerned, in view of Güttinger's wave-mechanical calculations [see Abstract 488 (1931), is discussed in relation to new experiments. With neither of these values for i is there a complete agreement between experiment and theory. Even with considerable intensity in the source of light, no splitting up into components is observed for Li^6; even if it exists it must be smaller than one-fifth of that of Li^7. H. N. A.

·1266. Measurement of the Life of Excited Helium Atoms, and a Direct Method for Determining the Coefficients of Diffusion of Excited Atoms. E. Ebbinghaus. *Ann. d. Physik*, 7. 2. *pp.* 267–292, *Nov.* 10, 1930.—Uses a modification of the optical method employed by Meissner and Graffunder, in which the absorption of light by the excited gas was measured in order to find how many excited atoms were present at given instants. The absorbing glass cylinder was provided with two parallel glass plates, the distance between which could be varied, and the absorption of the excited helium between these plates was measured for different distances and at different pressures. In this way it becomes possible, by means of the theory for the decay of the excitation, to eliminate the effect of collisions with the walls, and to find the diffusion coefficient of the excited helium, and the effective number of collisions for 1 mm. pressure. It is then possible to calculate the effective diameter of the excited helium atom in the 2^3S_1 state. This, in accordance with theory, is greater than that of the unexcited atom; using the experimentally determined coefficient of diffusion for 1 mm. pressure and room-temperature ($k_1 = 400$ cm.^{2}/sec.), and $\sigma_n = 2\cdot5 \times 10^{-8}$ cm. as the diameter of the normal helium atom, the diameter of the excited 2^3S_1 helium atom is found to be $\sigma_m = 4\cdot5 \times 10^{-8}$ cm. H. N. A.

1267. Para-Ortho Rupture and the Mean Value of the S Terms of Helium at High Quantum Numbers. E. A. Hylleraas. *Zeits. f. Physik*, 66. 7–8. *pp.* 453–470, 1930.—Mathematical. By consideration of a primary perturbation at a high quantum number, and taking into account the polarisation of the atomic residue, the expression $E_{n,o} = -Rh/(n - 0\cdot22 \pm 0\cdot07)^2$ has been derived for the S term values of ortho- and para-helium. The experimental term values may be calculated from $E_{n,o} = -Rh/(n - 0\cdot219 \pm 0\cdot079)^2$, which is in good agreement with the theoretical equation. H. F. G.

1268. Numerical Calculation of the 2S Terms of Ortho- and Para-Helium. E. A. Hylleraas and B. Undheim. *Zeits. f. Physik*, 65. 11–12. *pp.* 759–772, 1930.—The fundamental ortho-helium term has been calculated to 1·689, in almost complete agreement with the quantum number determined experimentally. Calculation of the second S term of the para-helium yields the value 1·858, compared with the experimental value of 1·851. H. F. G.

1269. Fine Structure of Zinc Lines in the Visible and Ultra-Violet. W. Mohammad and P. N. Sharma. *Phil. Mag.* 10. *pp.* 916–921, *Nov.*, 1930.—Eighteen lines in the region from 8000 Å. to 2689 Å. have been photographed and the fine structure examined. The results are compared with those found by previous workers. J. H. A.

1270. Spark Spectra of Bismuth, BiII and BiIII. J. C. McLennan, A. B. McLay and M. F. Crawford. *Roy. Soc., Proc.* 129. *pp.* 579–588, *Nov.* 3, 1930.—Wave-lengths in the spectrum of a condensed discharge in heated bismuth vapour have been measured from 7050 Å. to 2000 Å., and those in the spectrum of a condensed spark between metallic terminals in hydrogen from 2000 Å. to 1340 Å. The results are utilised to identify the multiplet term structure of BiII and BiIII. Evidence of hyperfine structure was obtained in both spectra, and the effect, in a few cases, was very large. The simple one-electron doublet spectrum of BiIII is established to a considerable extent. Interesting features of the doublet spectrum of BiIII are the large ^2D and $^2F^\circ$ intervals and the resolution of the ^2G intervals. The structure of the two-electron spectrum of BiII is satisfactorily interpreted on the basis that almost complete *jj* coupling occurs between the electron. J. S. G. T.

1271. Hyperfine Structure of Bismuth. P. Zeeman, E. Back and S. Goudsmit. *Zeits. f. Physik*, 66. 1–2. *pp.* 1–12, 1930.—New investigations of the hyperfine structure and Zeeman effect of arc lines of bismuth are described, a number of micro-photometer curves of lines taken with a large grating being reproduced. These values are compared to and discussed with former data. The term scheme of bismuth and the intensity relations in hyperfine multiplets are considered, as well as "forbidden" components in the Paschen-Back effect. F. S.

1272. Paschen-Back Effect of Hyperfine Structure. S. Goudsmit and R. F. Backer. *Zeits. f. Physik,* 66. 1–2. *pp.* 13–30, 1930.—The theory of the Paschen-Back effect for ordinary multiplets is extended to apply to hyperfine structures, which depend upon a moment of the nucleus. The calculated values are compared with Back's observations on bismuth lines. F. S.

1273. Zeeman Effect of the Hyperfine Structure of the Thallium Line 3775 Å. E. Back and J. Wulff. *Zeits. f. Physik,* 66. 1–2. *pp.* 31–48, 1930.—The Zeeman effect of this particularly simple hyperfine structure has been experimentally determined at three very different field-strengths, the positions and intensities of the Zeeman components being compared with the values given by Goudsmit and Backer's theory [see preceding Abstract]. Theory and experiment agree with the highest accuracy for weak, medium and strong fields. In particular, "forbidden" Zeeman components are predicted accurately by the theory. F. S.

1274. Zeeman Effect in ZnH and CdH Bands. W. W. Watson. *Phys. Rev.* 36. *pp.* 1134–1143, *Oct.* 1, 1930.—The Zeeman effect in the $^2\Pi \rightarrow {}^2\Sigma$ bands of ZnH at λ4326 and CdH at λ4509 which involve strictly case (*a*) $^2\Pi$ states and $^2\Sigma$ states with large ρ-type doubling is reported in detail. Field strengths up to 30,400 gauss were used, together with a large concave grating in a parallel light mounting which gives a dispersion in the third order of about 1·44 Å. per mm. in this region. Intensity relations among the 12 branches of each band are discussed. The ρ-type doubling in the $^2\Sigma$ states is found definitely to be proportional to $K + \frac{1}{2}$ rather than to K. The positions and widths of the blocks of components for all the lines are computed by means of the quantum-mechanics formulæ of Hill [see Abstract 1877 (1930)]. Observed and computed patterns are shown to be in excellent agreement on a number of details unique to these bands. Diagrams and tables of data showing these details are given for $H = 16{,}400$ gauss for the lines of several branches. AUTHOR.

1275. Transverse Zeeman Effect of the Green Auroral Line. Proof of Existence of Quadripole Radiation. R. Frerichs and J. S. Campbell. *Phys. Rev.* 36. *pp.* 1460–1466, *Nov.* 1, 1930.—The transverse Zeeman effect of the green auroral line was photographed. The pattern is of the type (1), 2/1, in complete agreement with the prediction made by Rubinowicz on the basis of the theory of quadripole radiation. [See Abstract 2837 (1930).] AUTHORS.

1276. Zeeman Effect with Quadripole Spectral Lines. E. Segrè. *Zeits. f. Physik,* 66. 11–12. *pp.* 827–829, 1930.—Investigates the Zeeman effect in the S—D combinations of the alkali metals. It is shown that these combinations are the result of quadripole radiation. The theory of Rubinowicz with regard to the Zeeman effect with quadripole radiation is experimentally confirmed. H. N. A.

1277. Derivation of Intensity Formulæ by Quantum Mechanics. H. A. Kramers. *K. Akad. Amsterdam, Proc.* 33. 9. *pp.* 953–958, 1930. *In German.*—A mathematical paper extending Weyl's formulæ to the Zeeman effect and multiplets. F. S.

1278. Stark Effect of Some Helium Lines. K. Sjögren. *Zeits. f. Physik,* 66. 5–6. *pp.* 377–388, 1930.—The Stark effect of a number of lines in the visible part of the spectrum was measured by Stark's method of canal-rays in fields from 175 to 550 kV per cm. The following lines were investigated: 2S—3P, 2S—3D, 2P—4S, 2P—4D, 2P—4F, 2P—4P, *2p—4s*, *2p—4d*, *2p—4f*, *2p—4p*. Spectra are reproduced and tables of results given. F. S.

1279. Optics of the Reflection of X-Rays by Crystals. H. Seemann. *Ann. d. Physik*, 6. 1. *pp.* 1–46, *Aug.* 6, *and* 6. 7. *pp.* 793–824, *Oct.*, 1930.—A detailed discussion of the influence of the width of slit, the mosaic structure, the depth of penetration of the X-Rays into the crystal, on the width of the lines in the spectrum. It is shown that owing to the existence of a mosaic structure in crystals the X-rays penetrate to a depth a thousand or more times greater than that to be expected if crystals were ideally perfect. A detailed discussion is also given of the optics of the rotating crystal method. F. J. W.

1280. Lloyd Interference Experiment with X-Rays. W. Linnik. *Zeits. f. Physik*, 65. 1–2. *pp.* 107–110, 1930.—An experimental attempt is described to obtain interference fringes for X-rays using a mirror as in Lloyd's optical researches with visible light. Fringes are obtained and the variation of phase up to half wave-length for total reflection is demonstrated. A method for increasing the distances apart of the X-ray interference bands is indicated. W. V. M.

1281. Position and Structure of the Modified Line of the Spectrum of Scattered X-Rays. F. L. Nutting. *Phys. Rev.* 36. *pp.* 1267–1272, *Oct.* 15, 1930.—Measurements have been made by both photographic and single-crystal ionisation methods of the shift in wave-length of scattered X-rays at angle of about 170°. The photographic method was that introduced by Sharp, but the $K\beta$ line of molybdenum was used. Two exposures of several hundred hours each were obtained. Analyses of the microphotographic records gave, from the shift of the centre of gravity of the lines, $h/mc = 0\cdot02305$ Å. and from the shift of the peaks, $h/mc = 0\cdot02374$ Å. From the difference between different exposures, it is suspected that some hidden source of error is present, perhaps due to the effect of the $K\gamma$ line. Some 600 ionisation curves give as an average $h/cm = 0\cdot0240 \pm 0\cdot00024$ Å. These results, compared with those of other experimenters, fail to indicate any definite departure from the theoretical value of $h/cm = 0\cdot02422$ Å. This does not support the findings of Davis and Purks, who report a value of 0·022 Å. The form of the spectral lines observed seems inconsistent with a fine structure of the modified line such as reported by Davis and Purks [see Abstract 220 (1930)]. The modified line is, however, found to have a considerable natural breadth. AUTHOR.

1282. X-Ray Diffraction. Part I. Structure of Amorphous Carbon. Part II. Colloidal Solutions and Liquid Mixtures. Part III. Aromatic Hydrocarbons in the Solid and Liquid States. P. Krishnamurti. *Indian Journ. Phys.* 5. 5. *pp.* 473–501 *and* 543–558, *Oct.*, 1930.—Part I.—Amorphous carbon has hitherto been considered as identical with finely divided graphite, in spite of many important differences such as the diamagnetic susceptibility. Amorphous carbon, however, shows marked variations according to the method of preparation. The two most important factors are purity and the temperature of formation. The carbon discussed in the present work originated from the following sources: benzene and naphthalene, sugar, active charcoal (Kahlbaum), from C_2Cl_6 and from CCl_4, and finally Acheson graphite. A strong scattering at small angles to the primary X-ray beam is observed. The data indicate a highly anisotropic unit, of which the thickness is about one-third the length or breadth. This is in accordance with chemical behaviour, especially the oxidation of charcoal to mellitic acid and the power of adsorption. Part II.—Aqueous solutions of starch, tannic acid, and gum arabic have been investigated by X-rays. They show strong scattering at small angles to the primary beam, due to the dissolved molecules or micelles. The calculated molecular weights are: starch 6200, tannic acid 3134, gum arabic 2810. Acetic acid appears to be dissociated in very strong aqueous solution. Other organic compounds are also discussed. Part III.—A study of a number of aromatic hydrocarbons. Some suggestions are advanced relating to liquid diffraction effects in relation to molecular dimensions in the crystalline state. F. I. G. R.

1283. X-Ray Diffraction in Heated Liquids and in Solutions. V. I. Vaidyanathan. *Indian Journ. Phys.* 5. 5. *pp.* 501–524, *Oct.*, 1930.—In the scattering of X-rays at small angles by liquids, the diffuseness and contraction of the haloes generally increase with rise of temperature, the scattering for benzene at 25°, 100° and 210° C. being in the ratio 1 : 3 : 9, which is comparable with the value 1 : 2 : 4 for the scattering of light. At 25° the ratio of the intensity of the scattering by unit volume of liquid has the values of 3×10^{-6} and $1{\cdot}3 \times 10^{-6}$ respectively for water and benzene, which agree fairly well with the theoretical values calculated by the Einstein-Smoluchowski formula. With associated liquids like phenol, propionic and caproic acids, etc., the haloes appear due to the form and electrical polarity, rather than to the association of the molecules. Solutions of cane sugar and glucose were also examined. T. H. P.

1284. X-Ray Study of Vitrains. C. Mahadevan. *Indian Journ. Phys.* 5. 5. *pp.* 525–541, *Oct.*, 1930.—X-ray diffraction examination of vitrains of different compositions and ages reveals one intense (inner) and one faint (outer) halo for all the coals, these having spacings of 3·37 and 2·12 Å. respectively for the older coals and 3·50 and 2·21 Å. for the newer (tertiary coals). In all cases a general scattering between the direct spot and the haloes is noted, the intensity of this being approximately proportional to the sum of moisture content and volatile matter with the older coals; with the newer coals, the same intensity of general scattering occurs with an appreciably smaller amount of moisture and volatile matter. On dehydration of the coals, the general scattering clears to some extent and almost disappears when the volatile matter is expelled, the halo also becoming wider. The spacings " a " for the peak intensity of the halo for the residual products in all cases are the same as for the untreated samples. The sizes of the diffracting particles are calculated to the correct order of magnitude from Laue's formula for representative cases, and the values were found to be of colloidal dimensions in all cases. T. H. P.

1285. X-Ray Diffraction in Paraffin Wax and Vaseline. S. Tanaka and A. Tsuji. *Kyoto Coll. Sci., Mem.* 13. *pp.* 369–373, *Nov.*, 1930. *In English.*—The influence of temperature and mechanical operations were studied from X-ray diffraction patterns. The photographs taken at temperatures lower than the melting point have many spectral lines characteristic of the crystalline powder photographs. These lines generally decrease in intensity as the temperature rises, and vanish at last when the substances are in the melting state, while amorphous bands appear in other positions. One intense line, however, remains until the melting state is reached and then suddenly vanishes. This transformation occurs in a different manner for each substance. The effects of compression and rolling at the room-temperature were studied with paraffin wax and the following results were obtained: (1) the wax comes to have a fibrous structure, the axis of which is perpendicular to the surface of compression and rolling; (2) the crystal planes which produce the most intense reflection are also nearly perpendicular to the same surface. AUTHORS.

1286. Natural Width of X-Ray Lines. Part III. H. Mark and G. v. Susich. *Zeits. f. Physik*, 65. 3–4. *pp.* 253–265, 1930.—It is shown using a double spectrometer, that the Davis-Purks fine structure lines [see Abstract 1299 (1928)] do not appear in the K-series of molybdenum. [See also Abstract 2551 (1927).] A. C. M.

1287. Bluish-Grey Radiation from Incandescent Spots ("Brennfleckstrahlung") on the Anti-Kathode of the Lilienfeld X-Ray Tube. F. Rother and W. M. Cohn. *Phys. Zeits.* 31. *pp.* 687–691, *July* 15, 1930.—The bluish-grey radiation from incandescent spots on the anti-kathode of a Lilienfeld X-ray tube possesses a continuous spectrum with an intensity maximum at 450 μ. The spectrum has been studied over the range 520–225 μ, but it extends further into the ultra-violet than this limit. It has not been possible to resolve the spectrum. Further, its extent and intensity are independent of the nature of the material forming the anti-kathode. It is suggested that this radiation should be of considerable use as a source of continuous radiation for spectroscopic studies in the blue and ultra-violet. F. J. W.

1288. X-Ray Intensity Measurement by Ionisation. W. Roché. *Ann. d. Physik*, 7. 3. *pp.* 375–380, *Nov.* 10, 1930.—Comments on a paper by Schechtmann [see Abstract 3464 (1930)] dealing with the measurement of X-ray intensities, using the ionisation method, and criticises the conclusions drawn by Schechtmann, in particular in connection with (*a*) the distribution of the field in the ionisation-chamber, (*b*) the factors which govern the saturation-current. The author thinks that Schechtmann's experiments do not provide sufficient ground for his adverse criticism of the air-pressure and other ionisation chambers. A. C. M.

1289. Satellites of the Kβ_1 Line of Elements from Fe to Zn. S. Kawata. *Kyoto Coll. Sci., Mem.* 13. *pp.* 383–387, *Nov.*, 1930. *In English.*—In the course of experiments to determine the relative position of the absorption edge and the Kβ_2 line for the elements from Fe to Zn several new satellites on the short side of Kβ_1 and Kβ_2 are found. These appear to be the continuation of β'' and β''' observed by Druyvesteyn below Fe. [See Abstract 2933 (1927).] C. B. A.

1290. Fine Structure of Certain X-Ray Emission Lines. J. Valasek. *Phys. Rev.* 36. *pp.* 1523–1530, *Nov.* 15, 1930.—The Kα lines of Fe, Co, Ni, Cu, Mo and Ag, and the Kβ lines of Mo have been studied for possible fine structure with two different single-crystal spectrometers especially constructed for the purpose. No structure was found. The widths of the various α_1 lines and the β_1 line of Mo were measured. AUTHOR.

RADIOACTIVITY.

1291. Behaviour of Radioactive Deposits on Heating. W. Seith and A. H. W. Aten, Jr. *Zeits. f. phys. Chem.* 10. *Abt. B.* 4–5. *pp.* 293–298, *Nov.*, 1930.—Radioactive deposit from thorium was distilled in oxygen at 0·1 mm. pressure on to platinum foil. On heating indication of change was perceptible at 550°, and at 700° the uniform deposit collected into spots with clear spaces between, whilst a few spots appeared in a blank space which had been protected by a screen. Precisely similar results were obtained when hydrochloric acid gas replaced oxygen. With quartz as support the oxide film was more stable, probably due to formation of silicate. By condensing a film of thorium B chloride on a support of lead oxide it was shown that kinetic interchange occurred between the lead ions of the oxide support and those of the chloride. C. A. S.

1292. Half Value Period of Uranium II. E. Walling. *Zeits. f. phys. Chem.* 10. *Abt. B.* 6. *pp.* 467–475, *Nov.*, 1930.—A mean value of 340,000 years was found for the half value period of Uranium II with a maximum deviation of about ± 15 %. The half value time of Uranium I is $4 \cdot 5 \times 10^9$ years. Thus with each atom of UII there are in equilibrium 13,200 atoms of UI. If 238·0 is taken as the separate atomic weight of UI there would only be for the mixed element UI + II a practical atomic weight lower by 0·0003 unit. J. J. S.

1293. Atom Disintegration Processes. G. Beck. *Phys. Zeits.* 31. *pp.* 945–946, *Nov.* 1, 1930. *Paper read before the Deut. Physikertag., Königsberg, Sept.*, 1930.—The problem of the collision between an α-particle and an atom nucleus is dealt with. Quantum processes occur and short statements are made concerning five types: (1) elastic collisions (scattering); (2) inelastic collisions with emission of radiation; (3) inelastic collisions with excitation of the nucleus; (4) disintegration processes; (5) disintegration with consequent emission of radiation. J. J. S.

1294. Criticism of Geological Time Measurement. G. Kirsch. *Phys. Zeits.* 31. *pp.* 1017–1018, *Nov.* 25, 1930. *Paper read before the Deut. Physikertag., Königsberg, Sept.*, 1930.—By direct determination of the number of α-particles produced from thorium the half-life period of that element is found to be $1 \cdot 8 \times 10^{10}$ years, in agreement with the result of Heimann and McCoy, but not with that of Rutherford and Geiger. The reliability of age deductions from the lead/uranium ratio in bröggerite is discussed in relation to the author's theory of rhythmical variations thereof. Preliminary results with Morogoro pitchblende indicate a ratio of 0·091 ± 1 %, but with sometimes inexplicable differences between the ratios for the inner and outer portions of apparently sound crystals. For a reliable determination of age the atomic weight of the lead must be determined, and the absolute homogeneity of the crystal or crystals proved. This is not the case with Keystone or Karelian pitchblende, but is with that from Canada or Norway and bröggerite from Moss. As regards amorphous uraniferous minerals, *e.g.*, the silicates, it is suggested that there has been loss of lead, due possibly to heat or magmatic action, so that from such minerals information as to the date of widespread variations in the inner activity of the earth may be inferred. C. A. S.

1295. Penetrating Component of Cosmic Radiation Established by Absorption Measurements in Lake Constance, and Spectrum of Cosmic Rays. E. Regener. *Phys. Zeits.* 31. *pp.* 1018–1019, *Nov.* 15, 1930. *Paper read before the Deut. Physikertag., Königsberg, Sept.*, 1930. *Nature*, 127. *pp.* 233–234, *Feb.* 14, 1931.—The existence of a more penetrating component of cosmic radiation, for which $\mu = 0{\cdot}018$ per m. of water, has been verified by further investigations in Lake Constance in 1929–30. In these the ionisation chamber was protected from possible variations of radioactivity with depth. Observations were made at various depths down to 237 m., and further confirmation obtained by means of a Geiger-Müller electron counter tube similarly sunk. Analysis of the absorption curve showed four components, the relative intensities on entering the atmosphere and the absorption coefficients (per m. of water) of which are, respectively: 0·81 and 0·020, 6·4 and 0·073, and 16·35 and 0·21. The wave-length of the hardest, deduced by Klein and Nishina's formula, is $0{\cdot}63 \times 10^{-13}$ cm., whilst the transformation of a proton and electron into radiation would correspond to a wave-length of $1{\cdot}313 \times 10^{-13}$ cm. C. A. S.

1296. Transition Effect of Cosmic Radiation with Variation of the Absorbing Medium. E. Steinke. *Phys. Zeits.* 31. *pp.* 1019–1022, *Nov.* 15, 1930. *Paper read before the Deut. Physikertag., Königsberg, Sept.*, 1930.—The author's observations in Switzerland gave further evidence that the measured intensity of the cosmic radiation depends markedly on the absorption material and established experimentally the jerk which occurs in the absorption curve on passing from one absorbing material to another. Besides the Hoffmann transition effect the author found another effect—the absorption curve, *e.g.*, of iron to air did not take the expected course but showed an inflection which he sought to explain by new scattering radiation liberated in the iron. Further experiments with accurate apparatus have been recently made in Königsberg and absorptions which vary from those of Hoffmann have been obtained. With iron and lead there occurs at first a strong falling-off. This transition effect occurs with lead to air or aluminium. In the curves given with small thickness of absorbing layers no decrease of the radiation occurs, but an increase, which is greater the higher the atomic weight of the absorber. This bulge on the curve is explained as due to X-radiation produced by scattered electrons of the air (or Al) in the new absorber.
J. J. S.

1297. Cosmic Radiation and Terrestrial Magnetism. W. M. H. Schulze. *Phys. Zeits.* 31. *pp.* 1022–1025, *Nov.* 15, 1930. *Paper read before the Deut. Physikertag., Königsberg, Sept.*, 1930.—An analysis is made of the observations of various investigators with a view to finding if any connection exists between the phenomena of cosmic radiation and the disturbances of the magnetic declination. The result is negative. No perceptible influence of perturbations of the declination on the ionisation produced by cosmic radiation could be traced. J. J. S.

1298. Autographic Observations of Hessian Cosmic Ultra-Radiation on the Upper Sonnblick (3100 m.). R. Steinmaurer. *Akad. Wiss. Wien, Ber.* 139. 2*a*. 7–8. *pp.* 281–318, 1930.—The author gives a table of results obtained by others for this type of radiation some of which show the existence of a sidereal oscillation while others do not. Autographic records were obtained with two Kolhörster forms of radiation apparatus having a double oscillating system and a Wulf-Kolhörster apparatus with a two-needle electrometer and a nickel steel-quartz temperature compensator. Observations were made partly in a completely closed iron vessel 7·2 cm. thick and partly in a similar vessel open at the top. The observations were corrected to 760 mm. Hg and 18° C. and a constant charging potential. The accuracy of the observations is discussed. The measurements show a small daily period with the limits of error only a little greater than the irregular oscillations. The oscillation curve obtained from the closed and unclosed vessels is in general agreement with sidereal time, but this oscillation with sidereal time gives only the weakest part of the radiation. An oscillation of a second kind enters into the measurements. For the partially and wholly closed vessels the maximum absorption coefficients are $5 \cdot 15 \times 10^{-3}$ and $3 \cdot 6 \times 10^{-3}$ cm.^{2}/gm. The mean daily value of ionisation exceeds that at night by 1 %. No effects produced by cloudiness or precipitation could be established. During thunderstorms the ionisation increased by 2·7 % for the open and 1·7 % for the closed vessel probably because of accidental products and radium emanation. Finally, the reasons for two pieces of apparatus working side by side and under the same conditions giving different results are discussed. R. S. R.

1299. Comparative Measurements of High-Altitude Radiations in Northern Seas. W. Bothe and W. Kolhörster. *Preuss. Akad. Wiss. Berlin, Ber.* 25–27. *pp.* 450–456, 1930.—The measurements were made practically continuously on a voyage from Hamburg to Leith, the Orkneys, the Faroes, the west coast of Iceland, Spitzbergen, the North Cape and along the coast of Norway back to Hamburg. The object was to find out if any changes of intensity in the radiations took place, which could be ascribed either to geographical or to magnetic latitude. The authors have previously shown that the radiations are of corpuscular nature, and if so it is possible that the magnetic field of the earth will so deflect them that the intensity is greater in some regions of the earth than others. Considerable changes, due to screening or to radioactivity, took place in the readings near land; but the general conclusion was that, in the region studied, the intensity does not vary more than 5 %, if at all. Observations by other investigators are mentioned, and in particular those by J. Clay, who in the course of three voyages between Holland and Java has found that the intensity diminishes considerably towards the equator. H. N. A.

1300. Nature of Cosmic Rays. P. S. Epstein. *Nat. Acad. Sci. Proc.* 16. *pp.* 658–663, *Oct.*, 1930.—Discusses the hypothesis of the electronic nature of these rays, with relation to their intensity distribution on the earth. Their energy is assumed to be 10^9 volts. Electrons of this speed are deflected appreciably by the magnetic field of the earth, and the author derives as an approximate formula for the radius of curvature a, when they are moving normally to a field H, $a = V/H$, where V is the voltage corresponding to the energy. The equations of motion are complicated, but it appears that such electrons coming from outside the earth can only strike it in two limited zones around the magnetic poles. Practically all the countries where cosmic rays have been measured are outside these zones. H. N. A.

1301. Capture of Electrons by α-Particles. H. C. Brinkman and H. A. Kramers. *K. Akad. Amsterdam. Proc.* 33. 9. *pp.* 973–984, 1930. *In German.*—On the basis of Born's collision theory Oppenheimer [see Abstract 1506 (1928)] has calculated the effective cross-section for the capture of electrons in hydrogen. He finds that it is proportional to v^{-6} for great values of v, the velocity of the α-particle. The present authors consider Oppenheimer's calculation not unobjectionable and have, therefore, repeated the wave-mechanical calculation, following Oppenheimer in restricting themselves to the first Born approximation. For atomic hydrogen a value is obtained for the effective cross-section Q which is proportional to v^{-12} for great velocities of the α-particles and has a maximum for values of v in the neighbourhood of the velocity of the electron in its Bohr orbit. The values of Q are so small that a capture of electrons in hydrogen is hardly likely to be detected. The formulæ may be applied to calculating the approximate value of Q for air. Satisfactory agreement with experimental results is obtained. In particular, Rutherford's empirical law that Q is proportional to $v^{-5\cdot 6}$ expresses itself in the form that the capture of the K-electrons in the experimental range considered increases with increasing velocity, whereas for the more loosely bound L-electrons the capture decreases more rapidly than $v^{-5\cdot 6}$.
H. L. B.

1302. Focalisation Applied to α-Rays. S. Rosenblum. *J. de Physique et le Radium,* 1. *pp.* 438–444, *Dec.,* 1930. *Comptes Rendus,* 191. *pp.* 1004–1005, *Nov.* 24, 1930.—Among the different methods for distinguishing the α-rays which present different kinetic energies, the method of magnetic deviation has been almost exclusively used for precise measurements. In this we have two lines of work, the direct and the focalisation method. The latter, known and applied in the case of β-rays, has not hitherto found favour in the case of α-rays, mainly because it requires a very broad field of uniform and intense magnetic force such as the electromagnets hitherto available have not been able to supply. Now, however, the large electromagnet recently installed by the Académie des Sciences at the Office National des Recherches et Inventions has supplied the required field, and introduced a separating power a hundred times as great as has hitherto been available. The author discusses and compares the principles of the direct and the focalisation method, and describes, with drawings, two forms of apparatus which he has used in conjunction with the new electromagnet. He gives a study of the behaviour of α-rays from ThC. The author previously described a form of apparatus which he devised for obtaining a sufficient field from smaller electromagnets, and gave some results obtained with ThC.
A. D.

1303. Distribution of Direction of H-Particles Liberated by α-Rays from Aluminium. H. Pose. *Phys. Zeits.* 31. *pp.* 943–945, *Nov.* 1, 1930. *Paper read before the Deut. Physikertag., Königsberg, Sept.,* 1930.—In earlier investigations of atomic disintegration the author has observed three groups of H-particles set free from Al by α-rays from Po [see Abstract 1492 (1930)]. For investigating the distribution of direction of the H-particles α-rays of 3·72 cm. range and a thick Al foil were used, and absorption curves were measured at the angles 48°, 65°, 105°, and 135° between primary and secondary radiation. It was found that with increasing angle the ranges of the H-particles in all three groups are more limited; the yields do not change considerably, they are for two of the groups at 135° about 25 % to 30 % smaller than at 0°. The relatively small change of the yield with the angle is experimentally of importance since it is thereby shown that the assumption of a uniform distribution of the H-particles over the angle range, which has been hitherto always made for the calculation of the yield, is justified at least for Al in connection with the separate groups. Yet for a definite absorption thickness the yield may change very much with the angle. On the assumption that the α-particle is caught at the collision by the atom nucleus the change of the velocity of the H-particles with the angle between primary and secondary ray can be calculated from the energy and impulse law, as has been done by Bothe. J. J. S.

1304. Number of γ-Ray Quanta Emitted by RaD. E. Stahel and G. J. Sizoo. *Zeits. f. Physik,* 66. 11–12. *pp.* 741–747, 1930.—The γ-rays were measured using an ionisation chamber method. To obtain a high percentage absorption of the γ-rays in the ionisation chamber, the latter was filled with methyl iodide CH_3I at relatively high pressures up to 710 mm. Hg, the pressure being varied by heating the chamber. The object was to determine the number of nuclear γ-rays actually escaping from the atom, and the induced L-radiation of the atom was screened off with an aluminium filter. A magnetic field served to deflect β-rays and prevent their entering the chamber. Corrections were calculated for the loss of energy from the chamber by re-radiation by the iodine atoms of the CH_3I, and for the effect of γ-rays from RaE present in the source. The final result obtained was that for every 100 disintegrating RaD atoms $2 \cdot 4 \pm 0 \cdot 7$ γ-ray quanta are emitted. W. S. S.

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1305. Test of the Klein-Nishina Scattering Formula, with Short γ-Rays. L. Meitner and H. H. Hupfeld. *Phys. Zeits.* 31. *p.* 947; *Disc.,* 947–948, *Nov.* 1, 1930. *Zeits. f. Physik,* 67. 3–4. *pp.* 147–168, 1931. *Paper read before the Deut. Physikertag., Königsberg, Sept.,* 1930. —As source ThC'' was employed, as this gives an isolated hard γ-ray line, 4·7 X units, in addition to longer γ-rays which are easily filtered out. The absorption coefficient, which is due almost completely to scattering at these high frequencies, was determined for carbon, magnesium, aluminium, zinc, lead and some other elements. For carbon the scattering per electron, agreed with the theoretical value of Klein-Nishina, but for the heavier elements deviations in the direction of too large an observed scattering, were detecfed. The discrepancy increased with atomic number, but not apparently in a continuous fashion. The suggestion that the constituents of the nucleus may contribute to the scattering is put forward. W. S. S.

1306. Scattering of Hard γ-Rays. C. Y. Chao. *Phys. Rev.* 36. *pp.* 1519–1522, *Nov.* 15, 1930.—Measurements have been made on the scattering of γ-rays from ThC'' by Al and Pb. For Al the scattering is, within experimental error, that predicted by the Klein Nishina formula. For Pb additional scattered rays were observed. The wave-length and space distribution of these are inconsistent with an extranuclear scatterer, and hence they must have their origin in the nuclei. AUTHOR.

HEAT.

1307. Experimental Solution of the Problems of Heat Conduction by the Electric Tank Method. S. Nukiyama and K. Yosikata. *Tokyo Soc. Mech. Eng., J.* 33. *pp.* 20–23, *March*, 1930. *In English.*—Based on the similarity between the equation for heat conduction in the steady state, $H = AKh(T_1 - T_2)$, where K is the thermal conductivity, h is the thickness perpendicular to the plane of heat flow, and A is a dimensionless number, and that for electrical conduction, $I = Akh(V_1 - V_2)$, where k is the electrical conductivity, the authors determine the values of A by an electrical method, using a glass-lined tank filled with a liquid, which is a conductor, to a depth h. Two copper plates bent to the requisite shape represent the equipotential lines. The resistance is determined by the Wheatstone-bridge principle, using a valve oscillator as source and a two-stage amplifier and a telephone receiver as detector. E. G.

1308. Mechanism of Heat Flow in Fibrous Materials. J. L. Finck. *Bureau of Standards, J. of Research*, 5. *pp.* 973–984, *Nov.*, 1930.—A systematic investigation of the thermal conductivities of specimens composed of fibrous materials has been made. The experiments were designed to show the effects of such factors as density of packing, arrangement of fibres, kind and size of fibres, moisture content, air convection and radiation on the resultant conductivity of the specimens. Data on various mixtures of fibres were obtained, and it was found that in most cases the conductivity of the mixture lies between those of the constituents, taking the conductivity of each constituent which corresponds to a density equal to the density of the mixture. It was found that for a given fibrous material and a given density, the conductivity may vary by several hundred per cent, depending entirely on the arrangement of the fibres. The maximum conductivity is obtained when the fibres are parallel to and the minimum conductivity when the fibres are perpendicular to the direction of heat flow. There is included a discussion of the part which contact resistance between the fibres may play in the overall heat transfer. At very low densities it was found that radiation plays an important part in the heat transfer; air convection plays a very minor part. AUTHOR.

1309. Influence of Magnetism on the Thermal Conductivity of Paramagnetic Gases. H. Senftleben. *Phys. Zeits.* 31. *pp.* 961–963; *Disc.*, 963, *Nov.* 1, 1930. *Paper read before the Deut. Physikertag., Königsberg, Sept.*, 1930.—The effect has been investigated with O_2 and NO. The relative diminution of the thermal conductivity has been plotted for different pressures, with respect to the magnetic field, which was varied up to over 2500 gauss. It was found that the equation $-\frac{\Delta\lambda}{\lambda} = \frac{ax^2}{1 + bx + cx^2}$, where λ is the thermal conductivity, and $x = H\sqrt{T/p}$, H being the magnetic field intensity, p the pressure and a, b and c constants, gives curves which agree well with those observed. Hydrogen, water vapour, helium, argon, neon and nitrogen showed little or no effect. The thermal current was in all cases perpendicular to the magnetic field. H. N. A.

1310. Friction, Heat Conduction and Diffusion in Gaseous Mixtures. Parts XI and XII. M. Trautz, A. Meister and R. Zink. *Ann. d. Physik,* 7. 4. *pp.* 409–452, *Nov.* 20, 1930.—Part XI.—After a description of experimental methods, and details of preparation of the gases the friction coefficients of H_2, N_2, CO, C_2H_4 and O_2 were measured and good agreement obtained with the author's previously determined values over the range from room-temperature to 276·9° [see Abstracts 4060, 4061 (1930)]. The Sutherland constants were remeasured and again good agreement found with previous values. They were H_2 . . . 84·4, N_2 . . . 103·9, C_2H_4 . . . 241·4 and O_2 . . . 126·7. The mean relationships were estimated from the gas mixtures by means of the mixture equations. The closed triangle shows great similarity to the isobar-isosteres of the gases N_2 and CO, whilst for O_2 no great difference is noted. For these gases the values of q and F are nearly equal to unity, and their friction coefficients are linear. There is no noticeable dependence of q upon the temperature. The member $2\eta_{12} \cdot q_{12}^2/q_1 \cdot q_2$ is independent of the concentration. The characteristic temperature θ decreases with increase of molar weight, and the value of $M\theta$ increases mainly with the molar weight, but with rare gases periodically. In general the values lie between 17 and 26. The paper is illustrated by full numerical tables. Part XII.—The temperature relationship of the friction constant of medium heavy gases follows the Sutherland formula in the region 0° to 300° almost exactly. For lower temperatures a correction factor must be applied to the Chapman formula. Measurements have been made on various gases and recorded in the present paper over this low-temperature region. The friction coefficient of air was determined by relative measurements from 20° to 830° and a Sutherland constant of 111 gives good agreement with the results. By differential measurement with capillary tubes the friction coefficients of N_2, A and CO_2, between 20° and 700° were found. They differ only slightly from those obtained by the later method. By a differential method, using a tube with a widened end, the friction coefficients for H_2, He, Ne, CH_4, SO_2 and CO_2 between the temperatures 20° and 830° C. were obtained. For measurements on hydrogen, helium and neon, the formula of K. Onnes has been altered to $\eta = KT^n/(1 + C/T)$, and the correct values for n and C determined. The temperature relationship of C has been determined for the gases investigated, as also for HCl and Br_2. At higher temperatures the Sutherland formula is again valid. The cases of H_2, He and Ne in the neighbourhood of the critical temperature present an exception, for the Sutherland formula is no longer valid in this region nor at lower temperatures. As before, full experimental details and numerical results are given. S. G. B.

1311. Propagation of Heat by Natural Convection. D. Graffi. *Accad. Lincei, Atti,* 12. *pp.* 129–135, *Aug.,* 1930.—A mathematical study of the phenomenon of the transmission of heat by natural convection, or for the case in which the motion of the fluid is produced by differences of temperature in the midst of the fluid itself. By means of the theorem of uniqueness some theoretical results on the transmission of heat by convection are rendered rigorous. The principal theoretical result obtained in the discussion consists of a formula, in good accordance with experiment, that expresses the quantity of heat given up by a solid immersed in a fluid. This formula [see following Abstract], while it still contains an

unknown function to be determined experimentally, permits of a great reduction of the number of experiments necessary for solving the problem.
J. J. S.

1312. Transmission of Heat by Forced Convection. D. Graffi. *Accad. Lincei, Atti,* 12. *pp.* 229–233, *Sept., and pp.* 336–340, *Oct.,* 1930.—A theorem of uniqueness [see preceding Abstract] is proved that permits of rendering rigorous some results of practical interest in the transmission of heat by convection. From this is deduced a principle which the author calls "the principle of superposition of effects" and also a "principle of reciprocity" by means of which some formulæ on the transmission of heat can be reached in a correct way. The case of a fluid moving in a cylindrical tube is considered on account of its practical importance, but the results can be applied to other problems.
J. J. S.

1313. Utrecht Radiation and Temperature Measurements Related to Black Body Measurements through the Gold Point. L. S. Ornstein, D. Vermeulen and J. Wouda. *K. Akad. Amsterdam, Proc.* 33. 9. *pp.* 985–989, 1930. *In German.*—Three relative methods (photographic, pyrometric and two-colour) and two absolute methods (thermopile and pyrometer) for determining the distribution of energy in the spectrum of a light source are outlined. In order to relate these measurements to the international temperature scale, measurements are made with a black body whose temperature is determined by the melting point of gold. The construction and use of the black body, which is made of nickel, are described. The measurements of the absolute energy by means of the thermopile and the pyrometer can then be compared. It is found that the temperature which was previously used in the calculation of the energy was about 10° too high. With this correction the difference between the two methods is reduced from 2–3 % to 1–2 %.
C. B. A.

1314. Radiation Thermopile Design. F. A. Firestone. *Rev. Sci. Instruments,* 1. *pp.* 630–649, *Nov.,* 1930.—Previous formulæ for the design of radiation thermopiles to be used with a Thomson galvanometer are summarised and new formulæ for the design of thermopiles for use with D'Arsonval galvanometers are developed. A design of thermopile is described in which the cold junctions almost entirely surround the hot junctions, thus reducing drifts. In this design each element is constructed as a separate unit, and when all are completed they are simply stacked up and fastened together with one screw, thereby minimising the danger of breakage. The whole thermopile fits into a cubical, evacuated case only 10 mm. on an edge and, being so small, it can be used directly in front of an elliptical mirror which forms a small hot image, in some cases increasing the deflection due to a given radiation by a factor of 3. By a slight modification of the spectrometer, a thermopile having adjustable compensation can be utilised which, theoretically, will give almost no drifts due to changes in temperature of the optical parts of the spectrometer or of the surroundings. A convenient technique of construction is described.
AUTHOR.

1315. Construction of Thermocouples from Thin Wires. O. Kantorowicz and R. Reinecke. *Zeits. f. techn. Physik,* 11. 12. *p.* 547, 1930.—A convenient method of gold-soldering wires down to 0·02 mm. diameter is described.
J. H. A.

1316. Construction of Bismuth-Antimony Vacuum Thermoelements by Vaporisation. Protection of Silver Mirrors with Vaporised Quartz. H. C. Burger and P. H. van Cittert. *Zeits. f. Physik,* 66. 3–4. *pp.* 210–218, 1930.—Bismuth strips were deposited in a high vacuum from the vapours of the metals on a thin film of mica. Most of the bismuth strip was covered with a mica sheet, and an antimony strip was deposited slightly overlapping the bismuth strip, and prolonging it, forming a thermoelement. The contact between the two metals at the centre need not be broader than a few tenths of 1 mm. The width of the metal strips can be as low as 0·1 mm.; the mica film carrying them can be so thin as to show interference colours (less than 1 μ); good thermoelements have been prepared with the bismuth strip about 1 μ thick and the antimony 0·5 μ thick. The thermoelements are used in a vacuum. For most purposes they prove more sensitive than Moll's constantan-manganin element. The same apparatus which has been used for vaporising the bismuth and antimony above has been employed to vaporise quartz, and form a very thin deposit of quartz on the surface of a silver mirror. This does not greatly affect the reflecting power of the mirror, but has been found to prevent its tarnishing. H. N. A.

1317. Oxygen Bomb Calorimeter. E. Stansfield and J. W. Sutherland. *Canad. J. of Research,* 3. *pp.* 464–472, *Nov.,* 1930.—This paper describes a stainless steel Scholes bomb and the modification found necessary to reduce the time for temperature equilibrium, a new calorimeter equipment and a simplified method for correcting Beckmann thermometer readings. Notes on a vacuum cup calorimeter are also included. AUTHORS.

1318. Compressibility and Thermal Expansion of Petroleum Oils in the Range 0° to 300° C. R. S. Jessup. *Bureau of Standards, J. of Research,* 5. *pp.* 985–1039, *Nov.,* 1930.—Measurements of compressibility and thermal expansion are reported on 14 representative samples of petroleum oils from various sources over the pressure range 0 to 50 kg./cm.^{2} (gauge), and the temperature range 0° to 300° C. It was found from the results obtained on these samples that the compressibility and thermal expansion of two samples of the same specific gravity, but from different sources, differed more than 30 % at the higher temperatures, whereas oils of the same specific gravity and also the same viscosity had the same compressibility and thermal expansion within rather narrow limits. In other words, with a knowledge of the specific gravity and viscosity of the oils, it was possible to represent all the measured volumes within less than 0·5 % over the entire range of temperature and pressure covered by the measurements. AUTHOR.

1319. Melting Curve of Sodium Chloride Dihydrate to 12,000 Atmospheres. L. H. Adams and R. E. Gibson. *Am. Chem. Soc., J.* 52. *pp.* 4252–4264, *Nov.,* 1930.—For the sodium chloride-water system below 0·1° C. and at ordinary pressures, the stable solid phase in contact with saturated solution, is the dihydrate, although it is very difficult to start its formation. Above 0·1° C. the solid phase is NaCl. The present results examine the relative stabilities at 25° C., up to pressures of 12,000 bars (c.g.s. atmospheres). To this end the quantities measured were the volume change on melting and the pressure-temperature curve of the transition point (each to 12,000 bars). Two methods were used to measure the volume change. The latent heat of the transition is calculated both from the melting curve and from the solubility curves at atmospheric pressure, the agreement being fair, and the mean value being 32 cal. per gm. of dihydrate. The compressibility and density of the dihydrate are also computed from the data obtained. It is definitely established that the melting curve passes through a maximum in the neighbourhood of 9500 bars. J. H. A.

1320. Thermal Properties of Toluol. K. Nesselmann and F. Dardin. *Zeits. f. techn. Physik*, 11. 11. *pp.* 487–491, 1930. *Paper read before the Deut. Phys. u. Math., Königsberg, Sept.*, 1930.—The following properties were measured: (1) vapour pressure from 110° to 320° C.; (2) specific heat of vapour from 0·14 to 8 atmospheres (100° to 280° C.); (3) specific heat of liquid up to 275° C.; (4) specific gravity of liquid (0° to 90° C.); and (5) latent heat of evaporation (from 100° to 210° C., *i.e.*, up to 10 atmospheres). Equations for each of these quantities are given, and various other quantities calculated from them thermodynamically. These include the saturation specific heat, the specific volume of the saturated vapour, the heat content and the entropy. J. H. A.

1321. Total and Specific Heat of Petroleum Fractions with Their Relations to Other Properties. H. R. Lang, R. Jessel and A. H. Steed. *Inst. Petroleum Technol., J.* 16. *pp.* 783–813, *Nov.*, 1930.—Five samples, each boiling within a range of 25° C., were studied, the lightest fraction boiling from 75° to 100° C. and the heaviest from 175° to 200° C. For the higher fractions, the specific heat was measured by a continuous flow method, and was found to be a linear fraction of temperature; for the first and second fractions there is an appreciable rise, followed by a flat, in the curve, somewhat below the boiling point. This is attributed to the presence at these temperatures of vapour molecules. In addition, the first sample shows a slight rise near 0° C. due to solid molecules. Representing each set of observations by a best straight line, all five samples had the same temperature coefficient. Above 100° C. the total heat was measured, and not the specific heat. It agreed almost exactly with the equation extrapolated from the specific heat results. The "mean" molecular weight of each fraction was measured by observing the freezing-point depression of nitrobenzene. It was found that the apparent molecular weight was a (linear) function of concentration, and the results given are therefore extrapolated to zero concentration. The mean molecular weight was found to be a linear function of specific gravity and also of refractive index. The coefficient of expansion is also given. J. H. A.

1322. Saturated Vapour Pressure of Lithium. A. Bogros. *Comptes Rendus*, 191. *pp.* 560–561, *Oct.* 6, 1930.—Values are given for the saturation vapour pressure of Li at temperatures down to 459°. All results satisfy the relation $\log p = -6173/T + 5\cdot 44$, where p is the vapour pressure in mm. of Hg. The relative numbers of the two isotopes in the vapour can be obtained by a method similar to that used by Stern, Costa, Smyth and Compton in analysing molecular speeds in a mixture, since the lighter isotope will have a greater speed and *vice versa*. By having a plate moving perpendicular to the atomic stream, observation of the points of impact on the plate will give the desired ratio. [See Abstract 206 (1931).] R. S. R.

1323. Vapour Pressure and Critical Temperature of Fluorine. G. H. Cady and J. H. Hildebrand. *Am. Chem. Soc., J.* 52. *pp.* 3839–3843, *Oct.,* 1930.—Pure fluorine was generated by the electrolysis of fused potassium bifluoride in an improved copper apparatus, special precautions being taken to avoid the presence of impurities such as hydrogen fluoride, oxygen, oxygen fluoride, etc. Fluorine thus prepared has a constant boiling-point, as contrasted with the varying behaviour of samples collected in glass vessels. Over the temperature-range 72·5°–86·0° K., the vapour-pressure P (cm. mercury) is represented by the equation $\log_{10} P = 7\cdot3317 - \frac{406\cdot8}{T} - 0\cdot007785\,T$. The calculated boiling-point at 76 cm. mercury is 84·93° K. Critical data, obtained from experiments with glass capillaries, are: $T_c = 144°$ K. and $P_c = 55$ atmospheres approximately. The heat of vaporisation at the boiling-point, using the Clapeyron-Clausius equation, is 1600 cal. per gm.-mol.; or 1540 cal., if allowance is made for deviations from perfect gas laws. L. V. C.

1324. Real Gases and Vapours. E. J. M. Honigmann. *Zeits. f. techn. Physik,* 11. 11. *pp.* 474–478, 1930. *Phys. Zeits.* 31. *pp.* 1064–1065, *Dec.,* 1930. *Paper read before the Deut. Phys. u. Math., Königsberg, Sept.,* 1930.—In passing from the ideal gas, with the characteristic equation $Pv = RT$, to real gases, it is customary to correct this equation so as to obtain an equation $f(P, v) = T$. It is pointed out that there is no theoretical justification for expecting these particular variables to be simply related; the pressure and volume might be expected to depend on the heat content and internal energy, just as much as on the temperature. But, remembering the complicated dependence of specific heat on temperature and pressure, this would involve of necessity a complicated equation between P, v and T. The discussion of this conception leads the author to introduce a new thermodynamic function—the Callendar—which becomes identical with entropy for the case of an ideal gas. In general, it is so defined that $dH = (dU + APdv)/APv$, where U is the internal energy, A is the reciprocal of the mechanical equivalent of heat, and P,v have their usual meanings. It is stated that the equation of state derived is in numerical agreement with observation. Incidentally, it is pointed out that Carnot's function $1/T$ is not the only integrating factor for the differential dQ. Others are $1/APv$, $1/(J\text{-}C)$, and $1/(U\text{-}C)$, where J is the heat content and C is a constant. J. H. A.

1325. Principle of the Inaccessibility of the Absolute Zero. H. Mache. *Phil. Mag.* 10. *pp.* 931–937, *Nov.,* 1930.—The paper is a reply to Kolossowsky. The latter complains that the attribution of this principle to Nernst is unjustified, and that it is really to be ascribed to Clausius. In the present paper it is pointed out that the meaning of the principle was quite different to the two authors. To Clausius it was a consequence of the second law of thermodynamics, but actually, when the vanishing of specific heats, to a higher order than the temperature, is taken into account, his proof is no longer valid. It would, in fact, violate the second law of thermodynamics. Thus Nernst's principle is essentially new, and the credit must be given to him. J. H. A.

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SOUND.

1326. Contribution to Theory of Hearing. G. v. Békésy. *Phys. Zeits.* 31. *pp.* 824–835, *Sept.* 15, *and pp.* 857–868, *Oct.* 1, 1930.—An arrangement is described for producing bilateral sound effects with given time-difference and given ratio of sound intensities. The effect of fatigue on the direction of hearing is then investigated, and it is found that fatigue phenomena may be traced to a change in the intensity ratio. Next, the paths described by the sound image when a change is made in the time-difference are investigated, and three image paths are found corresponding to three optical inversions of a black and white diagram. These three image-paths are discussed. A formula is obtained for the time-difference which compensates a unilateral increase in intensity, and its applicability is tested. Further, a formula is given for observers for whom the Hornbostel-Wertheim constant does not change with the intensity. This gives the displacement of the image on the rectilinear image-path as dependent on the unilateral increase in intensity. G. E. A.

1327. Observation Method for Non-Stationary Sound Waves. E. P. Tawil. *Comptes Rendus,* 191. *pp.* 998–1000, *Nov.* 24, 1930.—This paper contains the full description of a method for rendering visible sound waves propagated through gases, without recourse to stroboscopy or to stationary waves. H. H. Ho.

1328. Propagation of Air Waves in a Long Pipe. T. Vautier, R. de la Boulaye and G. Balme. *Ann. de Physique,* 14. *pp.* 263–626, *Nov.,* 1930.—Continuation of a previous research [see Abstract 1089 (1927)] on wave phenomena in a cylindrical tube 1640 m. long and 1 m. in diam., closed at both ends. The death of Vautier intervened at the end of the work, and his assistants have carried through the publication of this voluminous report of the results. The waves were produced by the detonation of fulminate of mercury and of gun-cotton, the combustion of black gunpowder and by simple mechanical compression. The waves were registered photographically by the displacement which they caused in the fringes of an interferometer. Wave forms were obtained from measurements of the photographs. The speed of short waves tends to decrease to a limit, whereas the speed of long waves is uniform. At 0° C. in dry air, the average speed of explosive waves is 330·4 m/s. The front, peak and tail of a wave have speeds which, at first equal, change at different rates, causing the wave to spread out. Amplitude is taken to mean the pressure at the peak of the wave, and the amplitude ratio for consecutive passages of the wave gave information from which the reflection coefficient K, and the decay factor could be determined; K was 0·96 for short waves and 0·97 for long waves. Values are tabulated for K, m and γ, where m is the constant in Helmholtz's equation $a = a_0 . e^{-mL}$, L being the distance gone, and γ is Kirchhoff's constant. The order of magnitude of m is 10^{-6}, whilst γ has a value 0·62. Other features studied were the discontinuities observed in certain types of wave, the carry of the wave and secondary waves. Many points are expanded in the Appendix, and the gradual decay of each wave as it passes to and fro along the tube is illustrated by numerous graphs. G. E. A.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

1329. Contact Potentials. Part I. Contact Potentials between Metals and Insulators. F. Polednik. *Zeits. f. Physik,* 66. 9–10. *pp.* 619–631, 1930.—The principle of Hankel's string electrometer is used to determine the contact potential of various metals with respect to quartz and glass in a vacuum. It is found essential to carry out these experiments in a high vacuum (of the order of 10^{-5} mm.) to ensure the dryness of the surfaces used. The results, which can be successfully repeated to a considerable degree of accuracy, are exhibited in the following table:—

Metal.	Contact Potential in Volts with Respect to		Melting Temperature in ° C.
	Quartz.	Glass.	
Platinum	+ 2·22	+ 1·15	1760
Iron	+ 1·99	+ 1·15	1500
Copper	+ 1·60	+ 0·58	1084
Gold	+ 1·60	+ 0·58	1064
Silver	+ 1·42	+ 0·58	961
Aluminium	+ 0·93	+ 0·14	660
Magnesium	+ 0·93	+ 0·14	630
Zinc	+ 0·45	− 0·29	419
Lead	+ 0·16	− 0·60	327
Tin	− 0·30	− 1·14	232

The last column shows that the order of the temperatures of fusion of the metals is the same as that given by their contact potentials with respect to the two dielectrics used. H. L. B.

1330. Contact Potentials. Part II. Potential Differences between Salts and their Saturated Solutions. Marianne Lederer. *Zeits. f. Physik,* 66. 9–10. *pp.* 632–645, 1930.—The principle of the quadrant electrometer is applied in investigating the contact potentials of solid NaCl, KCl, $NaNO_3$, $Ba(NO_3)_2$ with respect to their corresponding saturated solutions. The measurements do not lead to absolute values of these potentials but allow their differences for any two of these salts to be determined. A table of results is given and the order of accuracy stated. H. L. B.

1331. Volta Potential between Pure Metals. H. Kösters. *Zeits. f. Physik,* 66. 11–12. *pp.* 807–826, 1930.—The Volta potentials between tungsten, tantalum, molybdenum, nickel, copper and chromium have been measured by Mönch's method in high vacuum, the tube containing the metals being cooled in liquid air. Heating the metals to remove occluded and adsorbed gases causes first an increase and then a decrease of the surface potential, but the total variation is not more than a few tenths of a volt, and the final value remains constant for many hours.

With tungsten, tantalum, and molybdenum the potentials are constant and readily reproducible and are in quantitative agreement with the work of electronic separation as calculated from emission experiments. The Volta potential of a substance is, therefore, considered to be a true constant and not merely a result of the condition of the surface. The measurements with nickel-copper and chromium-tungsten are regarded as less satisfactory. H. F. G.

1332. Localisation of the Volta Effect. E. Perucca and G. Wataghin. *N. Cimento*, 7. *pp*. 337–343, *Nov*., 1930.—It is shown that the electronic theory of Sommerfeld based on Fermi's statistics gives a simple solution of the difficulty connected with the problem of the localisation of the Volta effect in relation to the Peltier effect. This theory permits also of forming a clear view of the mechanism of the phenomena of the Volta and Peltier effects. J. J. S.

1333. Decrement and Frequency of Piezoelectric Quartz. M. Boella. *Elettrotecnica*, 17. *pp*. 734–736, *Nov*. 15, 1930.—A quantitative study of the way in which the changes in the decrement of quartz affect the frequency of a Pierce piezo-oscillator. Devises an arrangement in which the oscillations take place near the point of series resonance, where the effect upon the frequency is reduced to one-tenth. Points out the importance of this for standards of frequency. E. E. F. d'A.

1334. Relaxation Oscillations Produced by Piezoelectric Quartz Oscillator. P. Kao. *Comptes Rendus*, 191. *pp*. 932–934, *Nov*. 17, 1930. —Explains the production of beats, with somewhat variable periods of the order of 0·5 sec., which take place when a quartz oscillator is connected between the grid and the filament of a triode valve, with an anti-resonant circuit in the anode circuit. The frequency of this circuit can be altered by means of a variable capacity, so as to pass through one of the fundamental frequencies of the quartz. The phenomenon is compared with that observed when a neon tube lights up periodically by discharging a condenser charged continuously by a battery through a high resistance. H. N. A.

1335. Vibrations of Piezoelectric Quartz Along the Optical Axis. P. Kao. *Comptes Rendus*, 191. *pp*. 768–770, *Nov*. 3, 1930.—Curie's law states that the direction of the optical axis does not partake in the piezoelectric phenomenon, but many specimens have three frequencies, related to the electrical axis, the optical axis and the axis at right angles to these two. The author shows experimentally that in cases where only two fundamental frequencies are ordinarily observed, one due to vibrations along the electrical axis and the other along the third axis, it is possible to observe vibrations along the optical axis by reflecting the vibrations along the third axis back to the crystal, in such a way that they interfere with the original vibrations in the crystal. The frequency of the vibrations along the optical axis is then found to be nearly the same as that of those along the third axis, but a little larger. The vibrations along the optical axis are not of piezoelectric origin, in the same sense as are those along the other two axes; they cannot be due to purely dielectric displacements. H. N. A.

1336. Dipole Moments of Naphthalene and its Monohalogeno-Substitution Products. A. Parts. *Zeits. f. phys. Chem.* 10. *Abt. B.* 4–5. *pp*. 264–272, *Nov*., 1930.—The dipole moments of naphthalene and of its eight monohalogeno-substitution products have been determined from the dielectric constant measurements of their solutions in benzene. For naphthalene, $\mu = 0$. The 2-halogeno-naphthalenes possess 0·13 to $0{\cdot}15 \times 10^{-18}$ larger moments than the corresponding 1-halogeno-isomers. The replacement of chlorine by bromine or of fluorine by iodine does not give rise to any alteration of the dipole moment. All the halogens give rise in the 1-position of naphthalene to the same moment as in the benzene nucleus. The densities and refractive indices for 1-fluoro- and 1-iodo-naphthalene have been determined for the lines H_β, D, H_α, and also the melting points of 1-fluoro and 1-chloronaphthalene. H. H. Ho.

1337. Dipole Moments of Organic Sulphur Compounds and Related Substances. Part III. E. Bergmann, L. Engel and S. Sándor. *Zeits. f. phys. Chem.* 10. *Abt. B.* 6. *pp.* 397–413, *Nov.*, 1930.—This paper deals with the importance of dipole measurements in the stereochemistry of carbon [see Abstract 931 (1931)]. The "characteristic angle" ϕ of the substituent $-\mathrm{SC_6H_5}$ has been determined from the moment of diphenylsulphide (1·47) and of chlorodiphenylsulphide (1·76) to be 71°, and the valency angle of sulphur to be 142°. ϕ is scarcely influenced by *p*-substituents. The moments of dibenzylether (1·38), dibenzylsulphide (1·38), thioanisole (1·27), diphenylsulphide (1·47), diphenylselenide (1·38) and diphenyl telluride (1·14) show that the moments of such molecules can be determined not only *via* the valency angle of the central atom, but also from the polarisability. A comparison of benzene thiocyanate (3·59) and *p*-chlorobenzene thiocyanate (2·93) shows that $\phi = 127°$ for SCN, and similarly $\phi = 154°$ for $-$ CN, in agreement with the fact that *pp′*-dicyanodiphenyl possesses a finite moment. From the moments of diphenylsulphoxide (4·08), dibenzylsulphoxide (3·88) and nitrobenzene (4·08), it follows that the alleged semi-polar double bond in these compounds is not proven, and a steric explanation is discussed. The moments of *p*-fluoronitrobenzene (2·63) and benzylchloride (1·85) may also be theoretically evaluated from models with tolerable accuracy. H. H. Ho.

1338. Dielectric Properties of Rochelle Salt Crystals. P. Kobeko and J. Kurtschatov. *Zeits. f. Physik*, 66. 3–4. *pp.* 192–205, 1930.—Large values, up to 20,000, have been obtained for the dielectric constants of these crystals, sodium potassium tartrate, provided that good contact is made between the dielectric and the electrodes. The constant diminishes with the field intensity, and has a definite value for each intensity. It is shown that the exceptionally high dielectric constant cannot be explained as due to high voltage polarisation. When a potential difference is applied the distribution of potential in the crystal remains homogeneous. It is assumed that in an electrical field an orientation of dipoles takes place, and that there is an internal orientating field in this salt, of the order of magnitude 10^7 volt/cm., analogous to the Weiss field in ferromagnetic substances. The last assumption is confirmed by an investigation of the electrocalorific effect. There appears thus to be, in this case, a molecular field in a diamagnetic monocrystal. H. N. A.

1339. Dielectric Constants of Supercooled Sulphur and Sulphur Solutions. S. Rosental. *Zeits. f. Physik*, 66. 9–10. *pp.* 652–656, 1930.—A glass condenser arrangement with three dielectric layers has been devised for the determination of the dielectric constants of substances which corrode the metallic coatings of the ordinary condenser. The dielectric constant of liquid sulphur amounts to $3 \cdot 720 \pm 0 \cdot 003$ at 130° and on cooling the value slowly increases as a linear function of the temperature. Liquid sulphur obeys the Clausius-Mossotti law, with $p =$ const. and $= 0 \cdot 2628 \pm 0 \cdot 00006$, where $p = (\epsilon - 1)/(\epsilon + 2)\rho$, ϵ being the dielectric constant and ρ the density at temperature t. In the supercooled state the dielectric constant is connected with the temperature above 119°, and also obeys the Clausius-Mossotti law. On solidification the dielectric constant rises suddenly by 5–10 %, in this respect sulphur behaving differently from water and many organic substances such as methyl alcohol and nitrobenzene. Solutions of sulphur in benzene obey the Clausius-Mossotti law, but in carbon bisulphide a small increase of polarisation with temperature has been observed, and here the Lorenz-Lorentz mixture law finds application. H. H. Ho.

1340. Dielectric Constants of Liquefied Gases. J. C. McLennan, R. C. Jacobsen and J. O. Wilhelm. *Roy. Soc. Canada, Trans.* 24. *Sect.* 3. *pp.* 37–46, *May,* 1930.—This paper contains a description of the method and apparatus employed for the determination of the dielectric constants of liquid nitrogen, argon, methane and nitrous oxide. Tables of data are given and the observed values of the Clausius-Mossotti function are tabulated for those temperatures for which density data are available. For purposes of comparison there is also listed the value of $(n^2 - 1)(n^2 + 2)\rho$ for the substance under investigation in the gaseous state at ordinary temperatures. H. H. Ho.

1341. Dielectric Constant of Ammonia as a Function of Temperature and Density. F. G. Keyes and J. G. Kirkwood. *Phys. Rev.* 36. *pp.* 1570–1575, *Nov.* 15, 1930.—The dielectric constant of ammonia has been measured over a wide range of density at several temperatures. The Clausius-Mossotti function $(\epsilon - 1)V/(\epsilon + 2)$ was found to increase with increasing density. At the lower densities it was adequately represented by the following formula: $\frac{\epsilon - 1}{\epsilon + 2}V = \frac{4\pi N p_0}{3}\frac{1}{1 - \lambda\rho}$ where p_0 is the molecular polarisability, ρ the density, and λ a constant expressible in terms of the equation of state constants, A and b, as $\frac{32\pi^2 p_0^2 N^2}{45b}\left(1 + \frac{1}{3}\frac{A}{bRT}\right)$. Previous measurements of the dielectric constant of carbon dioxide are further discussed. AUTHORS.

1342. Investigation of Pressure Effects in Liquids by Means of the Pressure-Variation of the Dielectric Constant. F. Trendelenburg. *Zeits. f. techn. Physik,* 11. 11. *pp.* 465–474, 1930. *Paper read before the Deut. Phys. u. Math., Königsberg, Sept.,* 1930.—Oscillographic records of the change in the capacity of a condenser having concentric cylindrical electrodes are employed to study the behaviour of liquid dielectrics when subjected to rapid variations of pressure. The experimental arrangements and the theoretical basis of the procedure are fully reviewed. After compensating for temperature and density changes the results are in accordance with the variations predicted by the Mossotti theory. The dielectrics tested are oil and benzol up to a pressure of about 300 atmospheres. An extensive Bibliography and several oscillograms are appended. A. J. S.

1343. Intensity Gradients with Electrical Methods. A. Graf. *Gerlands Beitr. z. Geophys., Angew. Geophys.* 1. 3. *pp.* 286–292, 1931.—Reference is made to results obtained by Ludwiger [see Abstract 226 (1931)] on normal sites with electrodes at distances of 25 to 150 m. and giving a constant phase, while for distances of 10 m. the phase difference was only 1° to 2°. The author gives formulæ for the intensity gradients of an electromagnetic alternating field established by electrodes or coils. Determination of differences from the mean values for small distances gives an indication of local differences in the path, fractures or differences of electrical conductivity caused by changes of density. This use of the electromagnetic alternating field is advantageous, since it is independent of phase changes, and oscillations of ordinary magnitude in the magnetic field.
R. S. R.

1344. Relation between Magnetic Storms and Earth Currents. J. Bosler. *Comptes Rendus,* 191. *pp.* 961–963, *Nov.* 17, 1930.—Examination of the magnetic observations at Tortosa confirms the deduction from those at Greenwich and St. Maur, that variations in terrestrial magnetism are due to variations in earth currents and not *vice versa.* At Tortosa the north-south component of the earth current is about 15 times as strong as the east-west. The fact that the vertical component V of the magnetic field varies directly with the north-south component at Tortosa while independent thereof at St. Maur is attributed to the current sheet at the former place being inclined, due possibly to the presence of a vein of superior conductivity in the neighbourhood, while at St. Maur it is horizontal.
C. A. S.

1345. Ultra-Violet Light Theory of Auroræ and Magnetic Storms. E. O. Hulburt. *Phys. Rev.* 36. *pp.* 1560–1569, *Nov.* 15, 1930.—Using the latest theory regarding the upper atmosphere, discrepancies in the ultra-violet theory have been removed. For the average world-wide magnetic storm the author considers there is a sudden increase in the eastward ion drift due to the increased number of long free-path ions formed by the ultra-violet flare. The high atmosphere is heated by the flare and expands, this causing an outward motion of the ionised regions across the earth's magnetic field and a westward current in the high atmosphere with fewer long free-path and more short free-path ions. This excess charge from low latitudes falls into the high atmosphere at auroral latitudes with a maximum at 1 p.m. By diffusion a level of 100 km. is reached by 6 p.m. and the electrical currents circulate round a focus at 60°–70° N. and S. This current system produces the diurnal variation. The lower limits of long and short free-path ion bands of the polar atmosphere agree with the lower boundaries of streamers and the structureless luminosity of the aurora. The present theory is possible if the earth's resultant charge is below 50 coulombs. [See Abstracts 2603 (1929) and 2619 (1930).]
R. S. R.

1346. Experiments Relating to the Störmer Auroral Theory. E. Brüche and W. Ende. *Phys. Zeits.* 31. *pp.* 1011–1016, *Nov.* 25, 1930. *Paper read before the Deut. Physikertag., Königsberg, Sept.,* 1930.—The authors review the earlier work regarding an electronic stream to explain auroral phenomena and the basis of Störmer's theory regarding the action of the earth's magnetic field on this stream. Cases are considered for the motion of electrons (1) along the earth's equatorial plane and (2) near the magnetic axis for small inclinations to the magnetic lines of force. Examples are given of the various paths followed by electrons. Two forms of apparatus are described which have been used to exhibit these paths, and the results are shown in plates. R. S. R.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

1347. Conductivity and Back Voltage of Ionic Conducting Crystals. O. Beran. *Akad. Wiss. Wien, Ber.* 139. *2A*. 7–8. *pp.* 393–419, 1930.—The dependence of the permanent conductivity of solutions of sodium chloride and of the fused crystalline salt upon the strength of the field is investigated. The measurements were made up to high field strengths and to high temperatures, *viz.*, 200 kV./cm. and 220° C. respectively. The results showed that the permanent conductivity is dependent to a very great extent on the field strength at all temperatures up to 220° C. A new method is developed for the measurement of back voltage with high accuracy, and up to high voltages and temperatures up to 200° C. The results are greater than those previously obtained, and show a different dependence on temperature. In the range 4 kV./cm. to 33 kV./cm. the true conductivity increased from 30 to 50 % in the temperature range 100°–200° C. F. J. B.

1348. Concentrated Space Charges (Polarisation) in Iceland Spar. A. Joffé, D. Rojansky, K. Sinelnikov and Collaborators. *Zeits. f. Physik,* 66. 3–4. *pp.* 143–171, 1930.—The concentrated high-voltage space charge, and its distribution in the thin kathode layer, have been directly measured by grinding off the surface under suitable electrical conditions. The distance *d* between the plates of an "equivalent condenser" varied from specimen to specimen, and lay between 0·5 and 10 μ. This distance depended on the applied voltage, the current, the crystallographic direction, the temperature and the duration of charging. The space charge vanishes gradually by diffusion, and at room-temperature it takes months for the polarisation voltage to fall to zero. The final current value when the voltage is applied measures the conductivity of the polarised layer; this is far smaller than the conductivity of the usual Iceland spar crystals. The conductivity of Canadian calcium carbonate crystals is of the same order of magnitude as that of the polarised layer of Icelandic or Russian crystals. The Canadian crystals show no polarisation phenomena. An attempt is made to explain the phenomena theoretically. [See also following Abstract.] H. N. A.

1349. Electrical Conductivity and High-Voltage Polarisation in Sodium Nitrate Crystals. B. Hochberg and V. Joffé. *Zeits. f. Physik,* 66. 3–4. *pp.* 172–191, 1930.—The relations between the final current and the temperature and external difference of potential have been determined. The ratio of the e.m.f. of the polarisation to the applied potential diminishes when the temperature or the potential is increased, vanishing altogether in the region between 150° and 190° C. The space-charges which cause the polarisation are concentrated in thin layers at the two electrodes; they are to be ascribed to the presence of impurities, polarisation becoming smaller as purity increases. Impurities taken up by the surfaces from the electrodes increase the polarisation. If the surface is ground off, thus removing the impurities, the polarisation diminishes again. [See also preceding Abstract.] H. N. A.

1350. Electrical Conductivity of Amorphous Quartz. W. Gnann. *Zeits. f. Physik,* 66. 7–8. *pp.* 436–452, 1930.—The investigation is on the lines of that of Leiste on "pressed" amber. Immediately after the voltage is applied the current is relatively large; it falls off in the course of some hours to a constant value, the final current (*Dauerstrom*). To the initial current corresponds, when the voltage is cut off, a return current which falls off in time to zero. Initial, final and return currents depend greatly on the humidity, the surface currents being more affected than the currents through the quartz itself. Up to 20 % of relative humidity quartz insulates somewhat better than amber; but its conductivity increases more rapidly with the humidity than that of amber. The internal resistance is certainly $> 6 \cdot 10^{10}$ ohm. cm. The final current nearly follows Ohm's law. Bakelite C proved to be strongly hygroscopic. H. N. A.

1351. Conduction of Electricity in Liquid Dielectrics. D. H. Black and R. H. Nisbet. *Phil. Mag.* 10. *pp.* 842–862, *Nov.,* 1930.—The theory of conduction in gases is applied to conduction in liquid dielectrics. The fall of current usually known as "absorption" is attributed to the formation of internal resistances. It is found experimentally that in liquid dielectrics of the paraffin oil class space-charges are formed during the passage of the current and disappear slowly when the current is cut off. Further residual effects independent of the space-charges occur and are due only to resistances set up by the current. The gas theory is able to account for these facts. The law $R = R_0 + nI$, arrived at by gas theory for final steady currents, is checked for a wide range of field strengths. [See Abstract 598 (1929).] J. J. S.

1352. Specific Resistance of Silicon. A. Schulze. *Zeits. f. techn. Physik,* 11. 11. *pp.* 443–452, 1930. *Paper read before the Deut. Phys. u. Math., Königsberg, Sept.,* 1930. *Phys. Zeits.* 31. *pp.* 1062–1064, *Dec.* 1, 1930.—The specific resistance of specimens of silicon obtained from different sources has been measured over the temperature range 0° C. to the melting point. Several specimens showed a decrease in resistance as the temperature was raised until a minimum value was reached at about 200° C. Further increase in temperature was accompanied by an increase in the resistance until the temperature was of the order of 550° C.; above this temperature the resistance steadily decreased. These temperature effects are to be attributed to the presence of impurities, particularly oxide layers at grain boundaries, for it is shown that with specimens of pure silicon the temperature coefficient of the specific resistance is always positive. The breaks in the temperature-specific resistance curves noted by Koenigsberger and Schilling [see Abstract 849 (1910)] have not been obtained either with pure or impure silicon. Further, the polymorphic transformations to which these breaks were attributed could not be traced by measurements of the thermal expansion. It is concluded that silicon undergoes no polymorphic transformations between the temperatures of 0° C. and the melting point. F. J. W.

1353. Gas Charge in Metals under High Pressure. H. Jellinek. *Zeits. f. Physik,* 66. 7–8, *pp.* 543–557, 1930.—It is shown that the metals iron, palladium and silver, after appropriate "activation," absorb hydrogen and nitrogen under high pressures of the order of a few atmospheres. Measurements of the electrical resistance of the metals show that absorption of gas is accompanied by an increase of resistance, and an evolution of gas by a decrease of resistance. J. S. G. T.

1354. Properties of Sputtered Metal Resistors. L. C. van Atta. *Rev. Sci. Instruments,* 1. *pp.* 687–693, *Nov.,* 1930.—Satisfactory high resistances have been made by sputtering platinum on soft glass rods and embedding the rods in paraffin in glass tubes for protection. These resistances are useful for measuring small currents in conjunction with an electrometer by the resistance shunt method. When properly prepared they are found to change but slowly with age (tests lasted over 15 months), thus overcoming the principal defect of sputtered metal resistors. They fulfil the following requirements excellently: no trace of polarisation, a negligible temperature coefficient and Ohm's law is obeyed. AUTHOR.

1355. Hall Effect and Magnetic Properties of Some Ferromagnetic Materials. E. M. Pugh. *Phys. Rev.* 36. *pp.* 1503–1511, *Nov.* 1, 1930.—The Hall effect and the magnetic properties have been measured simultaneously with considerable accuracy in K.S. magnet steel and in hardened high carbon steel. The Hall effect is found to be a single-valued straight-line function of the intensity of magnetisation I, but is neither a single-valued nor a straight-line function of either the magnetic induction B or the magnetic field H. This is true on both the virgin curves and the broad hysteresis loops of these materials. The possibility of writing the Hall e.m.f. per unit current in a cm. square as $\epsilon = R_0H + R_1I$ is considered. In the materials measured here R_0 is less than $0{\cdot}005\ R_1$. The formula may hold for non-ferromagnetic materials, but it could not be tested so simply. AUTHOR.

1356. Tungsten-Molybdenum Peltier Effect. E. Blumenthal. *Ann. d. Physik,* 7. 4. *pp.* 470–488, *Nov.* 20, 1930.—The measurements were carried out on the principle of Barker. Iron-constantan couples are used for determining the temperatures of the two tungsten-molybdenum junctions, and these and two heating coils were contained in two thermos flasks. Measurements were made between temperatures from 1200° to 2000°. At 1100° Abs. the Peltier effect in tungsten-molybdenum is about one-fourth of the effect in tantalum-molybdenum. E. E. F. d'A.

1357. Influence of Atomic Physics on the Technical Application of Electrical Discharges in Gases. R. Seeliger. *Zeits. f. techn. Physik,* 11. 11. *pp.* 438–443, 1930. *Phys. Zeits.* 31. *pp.* 1056–1057, *Dec.* 1, 1930. *Paper read before the Deut. Phys. u. Math., Königsberg, Sept.,* 1930.—A review of recent researches on the subject. F. J. W.

1358. Behaviour of a Mercury-Vapour Arc with a Jet of Liquid Mercury as Kathode. A. M. Cravath. *Phys. Rev.* 36. *pp.* 1480–1481, *Nov.* 1, 1930.—A mercury-vapour arc in which the kathode was a jet of liquid mercury with a velocity up to 2400 cm. per sec. was built to see if a stationary kathode spot with moving mercury could be obtained instead of the usual moving kathode spot and stationary mercury. Usually the arc refused to run to the exposed part of the jet. When a kathode spot did appear on the jet, it moved in the usual irregular manner, and increasing the jet speed tended to make the spot leave the jet. AUTHOR.

1359. Use of Discharge Tubes in Electric Circuits. R. Ruedy. *Frank. Inst., J.* 210. *pp.* 625–644, *Nov.,* 1930.—A concise account is given of the application of different types of discharge tubes to various practical uses. The various sections deal with (*a*) voltage reducers, regulators and rectifiers, (*b*) gas-incandescent kathode rectifiers, (*c*) glow relays, (*d*) glow tube buzzers, (*e*) gasfilled photoelectric cells and (*f*) discharge tubes as light sources. A. W.

1360. Discharges in Neon. P. Johnson. *Phil. Mag.* 10. *pp.* 921–931, *Nov.*, 1930.—The electric force necessary to maintain h.f. discharges (wave-length 35 m.) in very pure neon has been measured. J. H. A.

1361. Liberation of Electrons from a Metal Surface by Positive Ions. Part II. F. M. Penning. *K. Akad. Amsterdam, Proc.* 33. *pp.* 841–857, 1930.—The earlier work [see Abstract 3081 (1928)], which attempted to establish whether or not neon positive ions with zero velocity could liberate electrons from metal surfaces, has been continued, using an improved apparatus. It is found that γ_0, the number of electrons emitted per positive ion at zero velocity, is between 0·03 and 0·05. The metal surface used was carefully degassed tungsten. The influence of changes in the metal surface on the value of γ has also been investigated, using neon ions of an energy of about 500 volts. The chief factors studied are the effect of impurities such as traces of grease and mercury vapour and superficial oxidation. For neon ions on pure tungsten $\gamma_{500} = 0{\cdot}20$; on tungsten containing mercury $\gamma_{500} = 0{\cdot}32$. F. J. W.

1362. Magnetic Analysis of Negative Ions in Mercury Vapour. W. M. Nielsen. *Nat. Acad. Sci., Proc.* 16. *pp.* 721–727, *Nov.*, 1930.—In continuation of previous work [see Abstract 2173 (1926)], the author discusses the character of the negative ions present in a beam of mercury electrons. The occurrence of negative ions for which m/e has the value 200 is established. J. S. G. T.

1363. Experiments with High-Velocity Positive Ions. J. D. Cockcroft and E. T. S. Walton. *Roy. Soc., Proc.* 129. *pp.* 477–489, *Nov.* 3, 1930.—α-particles from polonium have an energy corresponding to $5{\cdot}2 \times 10^6$ electron-volts, and a potential of $2{\cdot}6 \times 10^6$ volts would be required to give a helium nucleus an equal amount of energy. In the authors' experiments positive hydrogen ions are accelerated by a potential of 280 kV.; and while the energy of each ion is much less than that of the above α-particles, the number of ions that can be produced in the apparatus is so great that definite results can be obtained. The above high voltage is obtained by rectifying high voltage a.c. from a transformer; suitable thermionic rectifiers were constructed for this purpose and are described. Hydrogen canal rays were accelerated by this voltage and allowed to fall on targets of lead and a beryllium salt successively. Very definite indications of non-homogeneous radiations were obtained with a gold leaf electroscope as detector. The average hardness of the radiation appears to be about 40 kV., but harder components were present. No marked difference in intensity was observed between the radiations from beryllium and lead. H. N. A.

1364. Formation of Negative Ions. W. Hey and A. Leipunski. *Zeits. f. Physik*, 66. 9–10. *pp.* 669–685, 1930.—The production of negative ions in iodine and mercury vapours and in argon is investigated. Curves in which experimental results relating to the probability of the formation of negative ions in iodine vapour are plotted as ordinates against electronic velocities (expressed in volts) as abscissæ agree, for small velocities, with those given by Mohler. They exhibit a maximum probability of the formation of negative ions in the region of 2–4 volts and, with increasing electronic velocity, become parallel to the axis of velocities. The order of magnitude of the degree of probability of the formation of negative ions in iodine vapour is about 10^{-5}. The formation of negative ions in mercury vapour and in argon was established for electronic velocities exceeding the ionisation potential; the probability of their formation was also of the order 10^{-5}. J. S. G. T.

1365. Coherence Length of the Light Emitted by Canal Rays. E. Rupp. *Ann. d. Physik*, 7. 3. *pp.* 381–384, *Nov.* 10, 1930.—The author brings forward evidence to show that the conclusions of Straub [see Abstract 3814 (1930)], which did not agree with his own results, are unfounded. Photographic observations confirm the results previously obtained. J. J. S.

1366. Canal-Ray Collisions. C. Gerthsen. *Phys. Zeits.* 31. *pp.* 948–953, *Nov.* 1, 1931. *Paper read before the Deut. Physikertag., Königsberg., Sept.,* 1930.—Reviews recent researches on canal rays: measurement of the Rutherford scattering of hydrogen canal rays using a Geiger counter; velocities of secondary electrons emitted by metal foils bombarded with canal rays; collisions of singly ionised helium ions with atoms, yielding doubly ionised helium; energy dissipation of canal rays in passing through matter and range of canal rays in gases. W. S. S.

1367. Heats of Condensation of Electrons on Several Metals in Several Ionised Gases. C. C. van Voorhis and K. T. Compton. *Phys. Rev.* 36. *pp.* 1435–1439, *Nov.* 1, 1930.—Heats of condensation ϕ_- of electrons on electrodes of Mo, Pt and W coated with K were measured in the ionised gases A, Ne, He, N_2 and H_2, by measuring the heat developed in Langmuir collectors of these metals when a known number of electrons of known energy were received by it. The values of ϕ_- varied as expected for the different metals, but also showed decided dependence on the surrounding ionised gas, even though this were a highly purified inert gas. The highest and lowest values recorded were 5·21 volts for Pt in N_2 and 0·93 for W + K in He. There is evidence that the specific effect of a purified gas is due to its ions rather than its neutral atoms. The accuracy of the experimental determinations is well within 1 %. [See also Abstract 2592 (1927).] AUTHORS.

1368. Energy Losses of Electrons in Nitrogen. E. Rudberg. *Roy. Soc., Proc.* 129. *pp.* 628–651, *Nov.* 3, 1930.—An initially homogeneous beam of electrons was sent through nitrogen at a pressure of the order 0·01 mm. The resulting velocity distribution was determined by means of a special method of electrostatic deflection, which gives considerable resolution, and has a valuable focussing property when slightly divergent beams are used. Seven maxima have been observed, which indicate characteristic energy losses of the primary electrons in collisions. Some of these prove to be due to collisions with the electrodes. The strongest maximum, which is rather sharp, indicates a loss of 12·78 volts; this and another prominent maximum are apparently due to excitation of the first singlet levels of the nitrogen molecule, which are known from far ultra-violet spectra. Two other definite maxima are probably related to similar levels. No characteristic energy loss connected with the ionisation of the nitrogen K level has been found, though the test was rather a sensitive one. H. N. A.

1369. Elastic Scattering of Electrons in Molecular Hydrogen. H. S. W. Massey. *Roy. Soc., Proc.* 129. *pp.* 616–627, *Nov.* 3, 1930.—The theory of the elastic scattering of electrons by atomic hydrogen has been given by Elsasser, but it is difficult to verify it experimentally, since 50 to 60 % of atomic hydrogen is the maximum attainable. With molecular hydrogen the novel case arises of an axially symmetrical field, the number of electrons scattered through a given angle depending on the orientation of the molecular axis relative to the initial and final beams. The calculation must be restricted to electron velocities of such magnitude that resonance effects are not of importance, and elastic collisions must be considered. The scattering cross-sections of the molecules for different angles of scattering of the electron beams are calculated, using Born's theory of collisions. The results are plotted for 10,000-volt and 420-volt electrons; the curves indicate the existence of diffraction effects, which differ for electrons of different velocity. These effects would be very difficult to detect experimentally in hydrogen, since the peaks are small relative to the " atomic " background. Mark and Wierl have, however, obtained excellent diffraction rings with methane, using 36,000-volt electrons. H. N. A.

1370. Search for Radiation Accompanying the Scattering of Slow Electrons at the Surface of Incandescent Solids. E. Rudberg. *Roy. Soc., Proc.* 129. *pp.* 652–656, *Nov.* 3, 1930.—The chief difference between this investigation and previous work on the subject was that the bombarded substances were maintained at incandescence during the whole time of exposure. The electron scattering experiments had shown that if the target was allowed to cool down the characteristic maxima often diminished and disappeared. Observations were made in the visible region and the ultra-violet above 2300 Å. Some of the characteristic losses previously observed were small enough to correspond with these regions. The result of the investigation is that no appreciable radiations such as were looked for could be found. H. N. A.

1371. Electron Scattering. F. Kirchner. *Phys. Zeits.* 31. *pp.* 1025–1028, *Nov.* 15, 1930. *Paper read before the Deut. Physikertag., Königsberg, Sept.,* 1930.—The use of electronic waves in investigating the structure of solids is discussed. It is shown, for example, that these waves are useful in revealing the mosaic structure of crystals. F. J. W.

1372. Effective Cross-Section of Krypton for Slow Electrons. J. Holtsmark. *Zeits. f. Physik,* 66. 1–2. *pp.* 49–58, 1930.—This work follows the lines previously adopted for argon [see Abstract 3253 (1929)]. The atomic field of krypton as calculated by Hartree requires modification for the polarisation energy. Agreement with previous data by Ramsauer and Kollath is satisfactory. H. H. Ho.

1373. Present Position of Investigations on the Effective Cross-Sections of Gas Atoms and Molecules. R. Kollath. *Phys. Zeits.* 31. *pp.* 985–1005, *Nov.* 15, 1930, *and* 32. *p.* 80. *Jan.* 15, 1931.—The various methods that have been used to measure the effective cross-section Q of gas molecules and atoms by means of slow electrons are described and compared. The author has selected the results which in his opinion are most trustworthy and has given curves relating Q to the " root volt velocity " of the electrons for all gases hitherto investigated. He regards the curves obtained by Townsend and his collaborators as being important in that they are obtained by an essentially different method (which he, however, considers indirect and qualitative) from those of other authors. In the majority of cases he finds that the Townsend curves agree surprisingly well with those obtained by the Ramsauer and similar methods, and that they may be used to give a decision in doubtful cases where the latter methods give discordant results. For many gases all the $Q-\sqrt{V}$ curves hitherto obtained by different methods are shown. The paper concludes with an extensive Bibliography. H. L. B.

1374. Possible Explanation of the Selective Photoelectric Effect. R. H. Fowler. *Roy. Soc., Proc.* 128. *pp.* 123–130, *July* 1, 1930.—This paper should be read in conjunction with that of Campbell [see Abstract 616 (1931)]. Campbell takes the view that the presence of an electronegative element is a universal feature of the selective photoelectric effect. He suggests, on thermionic analogy, that this element forms a cement uniting a more electropositive layer (probably monatomic) on the outside to a massive but less electropositive metal on the inside. From the fact that the condition for the occurrence of the selective effect appears to be entirely a surface one the author concludes that the observed selectivity should be referred to D(W), the transmission coefficient through the surface potential field for an electron incident from within with energy W in its motion normal to the surface. General considerations indicate that the observed facts of selective photoelectric emission can be reasonably accounted for if D(W) shows a fairly sharp selectivity. Mathematical investigation discloses that if the distribution of potential through the surface layer is such as to form a potential " valley " between two potential " peaks " selective transmission occurs if the velocity of the electrons is such that the waves associated with them are capable of forming standing waves between the sides of the valley. That is, D(W) actually shows the sharp selectivity required by Campbell's qualitative theory. H. L. B.

1375. Influence on the Photoelectric Characteristics of Cæsium of Adsorption by Thin Layers of Salt. J. H. de Boer and M. C. Teves. *Zeits. f. Physik*, 65. 7–8. *pp.* 489–505, 1930.—An investigation of the adsorption of alkali metals by sublimed thin layers of salt is described. The optical characteristics of these metals are completely changed and are dependent on the nature of the substratum. With CaF_2 and with BaF_2 as underlying substance the photoelectric sensitiveness of the cæsium adsorbed in a monatomic layer is raised from $0\cdot17 \times 10^{-6}$ amp./lumen to $1\cdot6 \times 10^{-6}$ amp./lumen. Cæsium layers with more numerous atoms have sometimes a smaller sensitiveness, whilst at the same time the boundary wave-length is situated farther towards the violet. Cs_2O as substratum gives a very high sensitiveness (12×10^{-6} amp./lumen). The red limit is situated at 11,500 Å.; the photo-emission has a maximum at 6070 Å. Both values are thus strongly shifted towards the red by the adsorption. J. J. S.

1376. Spectral Distribution of the Internal Photoelectric Effect in Sodium Chloride Crystals Subjected to Plastic Deformation. M. N. Podaschewsky. *Zeits. f. Physik*, 65. 11–12. *pp.* 799–805, 1930.—The effect of plastic deformation upon the spectral distribution of the primary photoelectric current in natural and annealed crystals of rock-salt, pigmented by means of X-rays, is studied in the region λλ410–690 mμ.

It is shown that plastic deformation, in addition to effecting a general decreased sensitivity of the crystal, effects a displacement of the maximum sensitivity towards the side of longer wave-lengths. Increase of load causes the sensitivity to be further decreased and a further displacement of the maximum sensitivity, which may be as large as 30 mμ. The phenomenon in certain cases exhibits the effect of a time factor. J. S. G. T.

1377. Photoelectric Properties of Salts. H. Erbel. *Zeits. f. Physik*, 66. 1–2. *pp*. 59–68, 1930.—Werner has shown that CdI_2, $PbCl_2$ and KNO_3 are photoelectrically inactive under mercury light when thoroughly degassed [see Abstract 318 (1930)]. On addition of traces of water, however, they become active. Other gases such as nitrogen, oxygen, etc., are, however, without a similar effect. The salts show a sharp alteration with time, either a decrease or increase of sensitivity. Werner traced this alteration to the relation between the work function of the emitted electrons and the actual velocity of emission. Since Werner's work did not exclude the possibility of faulty vacuum technique the experiments have been repeated by the author with extreme precautions against the presence of adsorbed water and gases. The results have been exactly confirmed quantitatively. J. E.

1378. Polarisation and Photoelectric Conductivity of Rock-Salt Treated with X-Rays. P. Tartakowsky. *Zeits. f. Physik*, 66. 11–12. *pp*. 830–833, 1930.—Describes a qualitative method for deciding whether the conductivity electrons take part in the production of the polarisation. A thin plate of the crystal is taken, and on two opposite narrow edges electrodes are attached, one of which forms the kathode and the other, which is divided in the middle of its length into two parts, forms two anodes. The plate is placed between the poles of an electromagnet so that the lines of force pass through it perpendicular to its large surfaces. It is illuminated in the direction at right angles to the lines of force, and it is found that the currents in the two anodes are different, owing to the bending of the paths of the electrons in the magnetic field. H. N. A.

1379. Effect of Systematic Surface Treatment on Photoelectric Emission from Metals. R. F. Hanstock. *Phil. Mag.* 10. *pp*. 937–944, *Nov.*, 1930.—The photoelectric current, using electrodes made of an alloy of Ni and Cr silicates, has been measured for Cu, Ag, Au and Pt. In each case the metal was in the form of a strip 5 cm. by 5 mm. by 0·07 mm. and was enclosed in a fused quartz vessel containing air at low pressure. The specimen could be rubbed with a cylinder of nickel or of steel, so as to polish it, and the apparatus could be heated so as to anneal the metal. The photoelectric current was found to increase when the surface was rubbed, and the increase was almost linear for a few rubs, after which it became constant. The current could be restored to its initial value by annealing above 150° C. The effect was found with radiation in a band from 2260 Å. to 2330 Å. wave-length, as well as with the heterogeneous radiation from the arc. It shows no regular variation with gas pressure in the vessel. The possible explanations are classified, the one favoured being that polishing produces the "vitreous" layer investigated by Beilby. J. H. A.

1380. Cuprous Oxide Photoelectric Cells. W. Schottky. *Phys. Zeits.* 31. *pp*. 913–925; *Disc.*, 970, *Nov.* 1, 1930. *Zeits. f. techn. Physik*, 11. 11. *pp*. 458–461, 1930.—A cuprous oxide photoelectric cell is prepared by growing a layer of cuprous oxide on copper and partly covering it with gold leaf. On illuminating the cell with a thin line of light parallel to the edge of the gold leaf, electrons stream from the copper to the cuprous oxide without the application of any voltage. The current decreases exponentially as the distance of the line from the gold leaf increases. The author concludes that the photoelectrons originate at the boundary between copper and cuprous oxide after the rays have passed the dividing layer (*Sperrschicht*). E. E. F. d'A.

1381. New Photoelectric Cell. Part II. B. Lange. *Phys. Zeits.* 31. *pp.* 964–969; *Disc.*, 969, *Nov.* 1, 1930. *Paper read before the Deut. Physikertag., Königsberg*, 1930.—The paper continues the discussion of the solid dielectric cell previously described by the author [see Abstract 2646 (1930)]. The analogy with a crystal detector, if the ordinary cell is likened to a thermionic valve, is taken up and discussed. J. H. A.

1382. Infra-Red Sensitivity of Cæsium Oxide Photoelectric Cells. J. W. Ballard. *J.O.S.A.* 20. *pp.* 618–623, *Nov.*, 1930.—Measurements have been made of the relative spectral sensitivities of a number of cæsium oxide photoelectric cells to visible and infra-red radiations. For the region 5000 Å. to 8000 Å., where the results reported here overlap those of Koller and of Vedder, the sensitivities were found to check those previously reported. The infra-red response has been found to decrease gradually from the maximum at about 7750 Å. to approximately zero at 12,000 Å. AUTHOR.

1383. Search for a Thermal Analogy of the Barkhausen Effect. B. del Nunzio. *Accad. Lincei, Atti*, 12. *pp.* 125–129, *Aug.*, 1930.—To investigate whether the discontinuity of the process of magnetisation of ferromagnetic substances known as the Barkhausen effect has a thermal analogy, the author made experiments by varying continuously the temperature of a nickel wire while maintaining the magnetising field constant. An amplifier was included in the arrangement of one series of experiments, but the result was negative, the quick variations were not observed, nor when a telephone was included in the circuit was the characteristic crepitation heard which is produced by the discontinuity of magnetisation. It is probable that the thermal effect exists, but in order to reveal it there is need of apparatus of considerably more power than is required in the case of the magnetic effect. J. J. S.

1384. Susceptibility of Cerium Fluoride at Low Temperatures. W. J. de Haas and C. J. Gorter. *K. Akad. Amsterdam, Proc.* 33. 9. *pp.* 949–952, 1930.—The susceptibility of CeF_3 was measured between 293° K. and 14°·33 K. At higher temperatures the Curie-Weiss law is followed. At nitrogen temperatures, and below, deviation occurs similar to that found in Co salts. The nature of the deviation can be described as a decrease of the effective magneton number from 11·33 to 7·55. This result does not conform to the theory of Becquerel and Kramers for tysonite. [See Abstract 3018 (1929).] G. E. A.

1385. Magnetisation of a Ferromagnetic Substance Under the Influence of an Alternating Field. S. Procopiu. *J. de Physique et le Radium*, 1. *pp.* 365–372, *Nov.*, 1930.—Specimens of iron and of steel were placed in different constant fields, and an alternating field with frequency 50, or oscillating fields with frequencies of 10^4, 10^5 and 10^6, were superimposed, in some cases longitudinally and in others circularly. It was found that as the alternating or oscillating current is increased the magnetisation increases at first, reaching a maximum when the efficacious alternating or oscillating field becomes equal to the coercive field of the substance, and then diminishing as the current goes on increasing. If, then, the alternating field is diminished to zero, the continuous field remaining constant, the magnetisation increases to a value greater than the previous maximum value. This behaviour has been observed with frequencies of 50, 9×10^4, 2×10^5 and $2 \cdot 4 \times 10^5$. The change in magnetisation is much less with a frequency of $2 \times 10^6 (\lambda = 150$ m.). H. N. A.

1386. New Indeterminate Properties of the Electromagnetic Field. P. Jordan and V. Fock. *Zeits. f. Physik*, 66. 3–4. *pp*. 206–209, 1930.—By considering the measurement of electromagnetic fields by means of a single electron or proton, certain limitations are deduced for the possibility of an exact measurement of a component of the field intensities, in combination with an exact fixing of the space-time point to which the measured field intensity belongs. H. N. A.

1387. Diffraction of a Circularly Symmetrical Electromagnetic Wave by a Co-Axial Circular Disc of Infinite Conductivity. J. Bardeen. *Phys. Rev.* 36. *pp*. 1482–1488, *Nov*. 1, 1930.—A disc of infinite conductivity, whose radius is a, and whose centre is at the origin, lies in a plane which is perpendicular to the z-axis of cylindrical coordinates, r, z, ϕ. A circularly symmetrical electromagnetic wave of wave-length λ impinges on the disc, and the resultant field is required. The solution depends upon solving an integral equation of the first kind. When $2\pi a/\lambda < 1$, this equation reduces to an integral equation similar to Abel's which may be solved explicitly. As an illustration the solution is obtained for the diffraction of a wave due to an oscillating electric dipole whose axis is the axis of z. It is mentioned that these equations have been used in determining the power flow into the earth below a vertical aerial which is grounded by a circular disc lying on the surface. AUTHOR.

1388. Direct Determination of the Volume of the Electron. V. Posejpal. *Comptes Rendus*, 191. *pp*. 1000–1002, *Nov*. 24, 1930.—On the assumption that the ether has the corpuscular structure, the author derives the formula $\sigma/\rho = \pi r^2/m_{\mathrm{H}}$ for the specific diffusion of very penetrating γ-rays in hydrogen, where r is the radius of the ether corpuscle which is assumed to be spherical, and $m_{\mathrm{H}} = 1 \cdot 662 \times 10^{-24}$ gm., the absolute mass of the hydrogen atom. From the experimental values of σ/ρ, the same numerical value is found for r as that given by the electromagnetic theory for the radius of the electron, *viz*. $1 \cdot 9 \times 10^{-13}$ cm. This result supports the author's theory that the ether consists of neutrons. H. H. Ho.

APPARATUS AND INSTRUMENTS.

1389. Double-Range Electrostatic Voltmeter for 200 Kilovolts. H. Clark. *Rev. Sci. Instruments*, 1. *pp*. 615–620, *Nov*., 1930.—The electrostatic voltmeter described in this paper consists, from an electrical standpoint, of two meters which may be used in series or in parallel. Mechanically, however, it is essentially a single meter, since it contains only one moving part. With the parallel connection voltages between 15 and 100 kV. may be measured to within 0·1 %. With the series con-

nection and voltages between 100 and 200 kV. (one-half on either side of earth, the halves fairly well balanced) the error need not exceed 0·1 %.
AUTHOR.

1390. New High-Potential Electrometer. T. Wulf. *Phys. Zeits.* 31. *pp.* 1030–1032, *Nov.* 15, 1930.—The second part of a description [see also Abstract 3564 (1930)] of a string electrometer suitable for h.t. measurement. Details are given of several forms of the instrument, together with a description of the insulators used in the construction. G. E. B.

1391. Theory and Use of the Valve Potentiometer. Measurement of E.M.F. Part I. F. Müller. *Zeits. f. Elektrochem.* 36. *pp.* 923–934, *Nov.*, 1930.—The general physical fundamental principles of the valve and its application as a d.c. transformer are discussed. The application of the valve potentiometer is shown to be advantageous in those cases of e.m.f. measurements where the ordinary compensation methods are fraught with difficulties. Its use is indicated for the measurement of e.m.f. when practically no current has to be taken from the cell, and in cases when the internal resistance of the cell is very high. A suitable form is described and details of its use are given. F. J. B.

1392. Maintenance of a Standard of E.M.F. Standard Weston Cells. A. N. Shaw and H. E. Reilley. *Canad. J. of Research,* 3. *pp.* 473–489, *Nov.*, 1930.—The article describes a method for the maintenance of a standard voltage to within a few parts in a million. It was found that neutral saturated cells were superior to acid cells as independent standards for a period of years. The method consists in making a number of cells to standard specification and uniformity of container and speed of preparation. The differences in e.m.f. between each cell and one of them are measured repeatedly over a long period and certain rejection rules applied. If a specified proportion survive elimination, the initial reference mean may be established. Additional groups of cells, neutral and acid, are constructed and exchanges made with the laboratories. Analysis determines (*a*) the constants in the ageing equation for the reference batch and (*b*) the difference between the initial reference mean and the estimated value of the international mean. The ageing equation was found to be essential to increased precision. W. C. S. P.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

1393. Apparatus for Producing A.C. of Audible Frequency and Rectangular Form. W. Keil and R. Sewig. *Zeits. f. Instrumentenk.* 50. *pp.* 582–590, *Oct.*, 1930.—For physiological purposes, *i.e.*, the excitation of nerve tissue, etc., it is advantageous to have some means of producing a current of rectangular form having a duration varying from 0·1 to 0·0001 sec. with a current strength of 2·5 to 3×10^{-2} amperes. An apparatus is described which has been used in the Berlin Charité Hospital which is dependent on the use of a photoelectric cell upon which light is focussed and periodically interrupted by a rotating disc arrangement, operating on a stroboscopic principle. The resulting intermittent photoelectric current is then amplified by a 3-valve amplifier, which has a wide range of 50 to 10,000 hertz. Various illustrations of the actual apparatus and its connections are shown. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

1394. Production of Activated Carbon from Various Coals and Other Raw Materials. A. C. Fieldner, R. E. Hall and A. E. Galloway. *Bureau of Mines, Techn. Paper No.* 479. [30 *pp.*], 1930.—A satisfactory quality of activated carbon can be produced not only from cocoanut and other nut shells, but also from anthracite coal and from anthracite or other carbon dust mixed with pitch, petroleum oil or carbohydrates, briquetted, baked and activated. The methods for producing activated carbon from cheap raw materials, the relative values of such materials and the properties of the carbons are described. The best active carbons for gas masks are obtained from anthracite coals having the highest carbon content and the lowest ash, volatile matter and sulphur content. A. J. M.

1395. Stabilising Action of Adsorption Films of Boundary-Surface Active Materials on Disperse Systems. Part II. Stability of Bubbles and Drops on Surfaces of Separation. P. Rehbinder and E. Wenström. *Kolloid Zeits.* 53. *pp.* 145–158, *Nov.*, 1930.—Several definitions for stability of disperse systems are discussed. It is shown that the maximum degree of stability of aqueous suspensions (of graphite and carbon) and emulsions (*e.g.*, aqueous mercury emulsions) by the addition of surface active substances of sufficient boundary-surface active stability is attained by completely satisfying the adsorptive surface. Foam possesses in certain cases " liquid " adsorption surfaces (i-amyl alcohol in water). The results of Bartsch are confirmed. In certain cases " semi-solid " adsorption surfaces are shown. Ways of measuring and considering the emulsification and foam building capacity are given with reference to the life of an air bubble on the free surface of a solution of boundary-surface active substances as well as for droplets of one of the two of the contracting liquids on their smooth surfaces of separation. [See also Abstract 3260 (1930).] J. K.

1396. Derivation of Planck's Radiation Law from the Standpoint of Adsorption. A. Ganguli. *Zeits. f. Physik,* 66. 1–2. *pp.* 137–142, 1930.—The equilibrium between matter and radiation is considered to be similar to that between a gas and a solid. Applying the statistical method by which he has previously investigated the adsorption of gases [see Abstract 2312 (1930)], the author has developed the Planck distribution law. F. J. W.

1397. Synæresis of Silica Gel. J. Ferguson and M. P. Applebey. *Faraday Soc., Trans.* 26. *pp.* 642–655, *Nov.*, 1930.—Investigation of the synæresis [see Abstract 1696 (1929)] of silica gel shows that the volume of synæretic liquid expressed exactly equals the decrease in volume of the gel. The relation between the volume of liquid synæresed and the time is expressed by an S-shaped autocatalytic curve. Both the velocity of synæresis and the total volume of liquid synæresed increase with the original silica concentration of the gel at the time of setting and the velocity is approximately doubled for each 10° C. rise in temperature. The more alkaline the gel, the greater is the initial volume of synæresis, but the total volume finally synæresed is greatest with the most acid gel. The hydration of the micelles amounts to one molecule of water per one molecule of silica in neutral gels, but it increases with the alkalinity, being two molecules of water per one molecule of silica at $pH = 10$. T. H. P.

1398. Hypothesis Relating to Swelling Pressure. J. J. Bikerman. *Zeits. f. phys. Chem.* 151. *Abt. A.* 1–2. *pp.* 129–134, *Nov.*, 1930.—In true solutions the sources of forces are points, whereas in gels they are surfaces. Herein lies the difference between osmotic and swelling pressures, which otherwise follow the same laws; the same holds for concentrated systems. The attraction of the solvent by a dissolved molecule, measured by the osmotic pressure P, diminishes as the distance between the molecules increases. If the distance between the molecule and the place of the weakest attraction (with further removal of the molecule the attraction of another molecule prevails) is denoted by l, the law of osmotic pressure for ideal solutions gives $P = \frac{3kT}{8l^3}$. In swelling l is evidently the thickness of the adsorbed layer. When these magnitudes are introduced into the equation for P, laws are obtained which agree with the empirical laws for swelling pressure. With non-ideal solutions or concentrated gels, the osmotic and swelling pressures depend in the same way on l. T. H. P.

1399. Swelling of Gelatin in Solutions of Electrolytes. K. Rudsit. *Kolloid Zeits.* 53. *pp.* 205–218, *Nov.*, 1930.—The results of a large number of measurements with gelatins of various types show that the curves indicating the degree of swelling in electrolyte solutions regularly show two minima, at pH about 4·7 and 8·0. Between these is a "neutral maximum," the exact position of which varies slightly on either side of the neutral point according to the sort of gelatin. The neutral point, as that with equal numbers of hydrogen and hydroxyl ions, is distinguished from the point of equal actions of these ions, the isoergic point. The boundary of action of the ions in the swelling of gelatin depends on but is not identical with, the isoergic point. The curve showing the swelling in NaCl solutions of different concentrations is of similar type to those for NaOH and HCl. The effect on the swelling of adding NaCl to NaOH or HCl solutions has been investigated. T. H. P.

1400. X-Ray Investigation of the Structure of the Gelatin Micelle. K. Herrmann, O. Gerngross and W. Abitz. *Zeits. f. phys. Chem.* 10. *Abt. B.* 4–5. *pp.* 371–394, *Nov.*, 1930.—X-ray examination of unstretched, air-dried gelatin reveals the existence of two new interference rings, in addition to the four already observed. Results are given also of a similar investigation of the changes occurring when gelatin swells in water and when it is stretched, and on these is based a view of the structure of gelatin, which represents this as a fringed micelle and is a modification of that advanced by Meyer and Mark for other substances of high molecular weight. This view, when considered in relation to the mechanical and elastic properties of gelatin gel and sol, agrees with the results of other investigators and, moreover, furnishes a feasible explanation of the formation of gelatin from collagen and of the textural structure of collagen itself. T. H. P.

1401. Orientation of Rolled Aluminium. J. Thewlis. *Phil. Mag.* 10. *pp.* 953–961, *Nov.*, 1930.—The orientation of a flat-rolled aluminium sheet has been determined by a graphical method. It has been found to be such that no definite direction in the crystal can be identified with the rolling direction or the normal direction. The mean position of the rolling direction is near a [353] direction, and that of the normal direction is near a $[\bar{3}\bar{1}5]$ direction. Four sets of crystals occur, the plane of the rolling and normal directions and the plane of the cross and normal directions behaving like mirror planes. This result confirms that of Göler and Sachs [see Abstract 837 (1930)]. The effect of the square-rolling of aluminium has been investigated. It has been found that a square-rolled rod, if rolled from an aluminium rod possessing random orientation, has the same orientation as a cold-drawn aluminium wire. It has been found that the square-rolling of an aluminium rod which has previously been flat-rolled produces an orientation in which the rolling direction is a [111] direction, the normal to one pair of faces a $[1\bar{1}0]$ direction, and the normal to the other pair a $[11\bar{2}]$ direction. AUTHOR.

1402. Precipitation and Change of Properties in Supersaturated Silver-Copper Solid Solutions. N. Ageew, M. Hansen and G. Sachs. *Zeits. f. Physik*, 66. 5–6. *pp.* 350–376, 1930.—Silver-rich and copper-rich alloys of silver and copper are quenched from 770° C. and annealed at lower temperatures. The effect of this treatment on the X-ray spectrogram, hardness and electrical resistivity is observed. The solid solubility of silver in copper at the eutectic temperature (779° C.) is 7 % by weight (4 % atomic) and of copper in silver is 9 % by weight (14 % atomic). At 250° C. the solubility on both sides is about 0·1 %. Besides the normal increase of resistance on annealing at lower temperatures, there is an abnormal increase. With low concentrations and precipitation at high annealing temperatures the change in hardness and the abnormal change in resistance are proportional to the atomic percentage of precipitate. With high concentrations and low annealing temperatures there is an abnormal increase in hardness in the early stages of the precipitation with no corresponding change in resistance. In general the increase in hardness on annealing is dependent on the mass of precipitate. A. J. M.

1403. Graphic Solution of Mixture Problems. U. Retzow. *Zeits. f. techn. Physik*, 11. 11. *pp.* 495–500, 1930. *Phys. Zeits.* 31. *pp.* 1029–1030, *Nov.* 15, 1930. *Mathematical. Paper read before the Deut. Phys. u. Math., Königsberg, Sept.*, 1930.—A graphical method is developed from the geometrical relations in equilateral and non-equilateral triangles whereby it is possible to solve such problems as the preparation of a binary alloy of a specified composition from three other binary alloys of known composition. A. J. M.

1404. Measurements with Liquid Helium. Part XII. Plasticity of Metal Crystals. W. Meissner, M. Polanyi and E. Schmid. *Zeits. f. Physik.* 66. 7–8. *pp.* 477–489, 1930.—The plastic flow of crystals of zinc and cadmium has been measured at liquid helium temperatures, extending the work previously done at − 252° C. The conclusions are not yet very precise, though it still seems true that the temperature coefficient of rigidity increases at low temperatures and ultimately becomes constant at a temperature where the " recovery " ceases to be measurable. J. H. A.

1405. Time Factor in Anodic Passivation of Metals. W. J. Shutt and V. J. Stirrup. *Faraday Soc., Trans.* 26. *pp.* 635–642, *Nov.*, 1930.—The results of experiments made mostly with a gold anode in acid chloride solution seem most readily explainable on the oxygen theory elaborated by Muthmann and Freunberger, Fredenhagen, Foerster, etc., and employed by Allmand and Puri [see Abstract 2799 (1925)] to explain the results of their work on the passivation of gold. By this theory the potential of an anode is essentially a matter of its oxygen content, the potential being more positive the higher the oxygen concentration. For a gold anode dissolving at an appreciable current density in hydrochloric acid solution, it may be assumed that some hydroxyl ions discharge along with the chloride ions, the proportion of oxygen so liberated increasing with the relative concentration of OH′ near the electrode. This oxygen is absorbed by the anode and possibly forms a solid solution with the metal, a dynamic equilibrium being reached at constant current density when oxygen escapes at the rate at which it is deposited. Thus, by this theory, the rate of anodic passivation of a metal is conditioned by the progress of two opposing processes: the accumulation of oxygen in the metal and the loss of gas by diffusion into the electrolyte. T. H. P.

1406. Kinetics of Formation of Molecular Hydrogen from Atoms. H. Senftleben and O. Riechemeier. *Phys. Zeits.* 31. *pp.* 960–961, *Nov.* 1, 1930. *Paper read before the Deut. Physikertag., Königsberg, Sept.*, 1930.—The authors have recently described a method [see Abstract 301 (1931)] by means of which they have investigated the return from the atomic to the molecular state, by measurements of the thermal conductivity of a mixture of atoms and molecules. The number of hydrogen atoms present at any instant can be determined by this means. They now determine the variations of the thermal conductivity at pressures of 60, 30 and 15 mm. of mercury, and in this way are able to distinguish between the effects of triple collisions between two atoms and a molecule, double collisions on the wall of the containing vessel, and triple collisions of three atoms. Determinations of the collision diameters of the atoms in triple collisions between three atoms, and between two atoms and a molecule, from the measured values of the constants in the differential equation for the rate of diminution of the atoms, give a ratio of 3·5 : 1, in agreement with the value previously obtained, *i.e.*, the effective sectional area of the atoms is about ten times as great in the first type of collision as in the second. In the second type the sectional area is nearly that of the kinetic theory of gases. H. N. A.

1407. Displacement by Ultra-Violet Light of the Explosion Limit in a Chain Reaction. C. N. Hinshelwood and K. Clusius. *Roy. Soc., Proc.* 129. *pp.* 589–598, *Nov.* 3, 1930.—It is shown that the effect of ultra-violet light in diminishing the lower pressure limit for the explosive reaction between phosphine and oxygen is due to the production of a small amount of active substance from the phosphine. This substance does not decay immediately when the illumination ceases; it increases the explosibility of the mixture by an action comparable with that of nitrogen peroxide on mixtures of H_2 and O_2. The conditions of formation and decay of the active substance have been investigated; the maximum concentration in the photo stationary state deduced, and the efficiency of collisions with the vessel wall in destroying it calculated. The process is an example of a chain reaction in which the existence of definite "material" chains rather than energy chains can be detected.
H. N. A.

1408. Condensation of Hydrocarbons by Electrical Discharge and by α-Rays. S. C. Lind and G. Glockler. *Am. Chem. Soc., J.* 52. *pp.* 4450–4461, *Nov.,* 1930.—Methane, ethane, propane, butane and ethylene have been studied and the reactions by the electrical discharge found to be quite similar to those caused by α-rays [see Abstract 339 (1929)]. The following factors illustrate this similarity: (1) the pressure changes as a function of the time; (2) the free hydrogen produced during the reaction; (3) the relative amount of hydrogen and methane in the hydrogen-methane fraction of the resultant gases; (4) the percentage of liquid conversion; (5) the average composition of liquid condensate; (6) the percentage of the hydrocarbons re-acted. It is therefore argued that both types of reaction must be caused by the same mechanism, and this is discussed on the basis of the ion cluster theory. The usual ideas are amplified in one respect, in that it is assumed that the larger molecules are ionised not only by electron impact but also by electron exchange. H. H. Ho.

1409. Gaseous Combustion in Electric Discharges. Parts VI and VII. G. I. Finch and W. L. Patrick. *Roy. Soc., Proc.* 129. *pp.* 656–671 and 672–685, *Nov.* 3, 1930.—In Part VI the effects of dilution with nitrogen, helium, argon, carbonic oxide and oxygen on the rate of combustion of carbonic oxide are studied, when an electric discharge passes through dry or moist detonating gas, together with the behaviour at non-sputtering and freely-sputtering kathodes. It is concluded that (1) carbonic oxide is auto-oxidised, the carbon thus formed being burnt directly by oxygen; (2) the fundamental mechanism of the direct combustion of carbonic oxide by oxygen consists in the union of carbonic oxide molecules with oxygen atoms in either pure or indirect triple collisions; and (3) metal atoms combine with oxygen molecules to form loose complexes which readily oxidise carbonic oxide. The conclusions arrived at in Part VII are: (1) The kathodic combustion of $CO—O_2—H_2$ mixtures proceeds in such a way that hydrogen burns, first, to active steam and H_2O_2, both of which then oxidise CO more readily than does oxygen, whereby the former is reduced to an active form of hydrogen and the latter to inactive steam. Some direct oxidation in manner outlined in Part VI may also occur, depending upon the conditions of pressure and hydrogen concentration. (2) Sputtered metal atoms decompose H_2O_2 to inactive steam. (3) Active H_2 burns readily to active steam and H_2O_2. (4) CO burns with H_2O_2 to highly activated CO_2 and inactive steam. (5) Active steam burns with CO to inactive CO_2 and active hydrogen. (6) Increasing pressure and/or oxygen concentration favours the combustion of H_2 to H_2O_2. (7) Decreasing pressure and/or decreasing oxygen concentration and/or increasing hydrogen concentration favours the combustion of H_2 to active steam. A future communication is envisaged to show that there is no fundamental difference between kathodic combustion and combustion in flames in general, and that the reactions taking place in both cases are homogeneous. [See also Abstract 1044 (1931).] A. J. M.

1410. Ignition of Carbon Monoxide-Oxygen Mixtures. Effect of Impurities. A. K. Brewer and W. E. Deming. *Am. Chem. Soc., J.* 52. *pp.* 4225–4238, *Nov.,* 1930.—It was shown by Brewer [see Abstract 210 (1928)] that a hyperbolic relationship exists between the gas pressure P and the minimum voltage V necessary for flame propagation in the explosive mixture $2CO—O_2$. The work is now extended to explosive mixtures of oxygen with ethyl alcohol, ether and carbon disulphide. The effect of impurities in the explosive mixture as positive and negative catalysts is shown to be exhibited by a similar hyperbolic relation, $(V - b)(p + a) = C$, where $(p + a)$ is the pressure caused by the impurity, V the ignition voltage, and b and C are constants for each catalyst. It is found that vapours which burn to form water as one product of combustion will be positive catalysts when present in a small amount and negative catalysts when present in a greater amount. An interpretation of these results is given as follows: (1) The voltage necessary to ignite a given explosive mixture is inversely proportional to the number of molecules in the path of the spark. (2) The ability of a positive catalyst to lower the voltage is proportional to the number of its molecules in the path of the discharge. T. B.

1411. Interaction of Inert Gases. M. Delbrück. *Roy. Soc., Proc.* 129. *pp.* 686–698, *Nov.* 3, 1930.—A study from a quantum-mechanical point of view of the inertness of the inert gases, considered as a special kind of chemical reaction. The problem of the best representation of an atom with n electrons in a ^1S state by a determinant of n independent functions can be reduced in a unique way to the determination of a much smaller number of independent functions. The electrostatic as well as the exchange-energy of two rare gas atoms can be written as a sum, the terms of which correspond to the interaction of pairs of completed shells: the electrostatic energy will always be negative for great distances, while the exchange energy tends to negative values for increasing azimuthal quantum numbers. The attractive field of the higher rare gas atoms is probably due to the first order perturbation, rather than to polarisation. A. J. M.

1412. Photochemical Formation of Chlorine Dioxide from Chlorine Monoxide in Carbon Tetrachloride Solution. R. G. Dickinson and C. E. P. Jeffreys. *Am. Chem. Soc., J.* 52. *pp.* 4288–4297, *Nov.*, 1930.—The effect of light of wave-length 4358 Å. on solutions of Cl_2O in CCl_4 has been investigated. It has been found that the decomposition of Cl_2O is accompanied by the formation of considerable ClO_2. In solutions 0·014 to 0·054M in chlorine monoxide, the initial rate of formation of chlorine dioxide has been found to be about 0·35 molecule per quantum absorbed. The initial rate of decomposition has been found to be at least 1·8 molecules of chlorine monoxide per quantum absorbed. H. H. Ho.

1413. Photochemistry of Associated States. F. Weigert. *Zeits. f. phys. Chem.* 10. *Abt. B.* 4–5. *pp.* 241–263, *Nov.*, 1930.—Associated systems which are sustained by van der Waals forces are investigated for the possible photo-change in connection with Franck's considerations respecting the photochemical dissociation of non-polar molecules. The conditions are discussed under which the excitation of the electronic systems of single molecules of the associated complexes and micelles can lead to their partial relaxation. The special phenomena, which are to be expected from the experimental conditions, are utilised for the explanations of a series of photo-effects, which are not given by the hitherto discussed molecular photochemistry. In all these cases photomicellar processes occur which appear to be very widespread. H. H. Ho.

1414. Photochemical Reactions from a Spectroscopic Standpoint. R. Mecke. *Zeits. f. wiss. Phot.* 29. 1–12. *pp.* 72–76, 1930.—It appears that the Einstein photoelectric law always determines the primary action and that apparent deviations from it are due to subsequent reactions. This involves the existence of a definite absorption edge for the molecule concerned, though the reaction may be sensitised by mixture with a substance which will absorb in the region required. In some cases at least it appears that there is no primary chemical reaction to supply the energy required, but that an excited molecule is the carrier of the required energy. In the case of the dissociation of NO_2 the reaction begins at 3700 Å. (77 Cal.), which corresponds exactly to the energy required to split off the oxygen, and is exactly the point at which predissociation begins. An important correspondence with this predissociation is the loss at the same point of fluorescing power, which is taken to mean that the excited molecule can either dissociate or else react in a collision of the second kind, but cannot return to the normal state with evolution of fluorescent light. Several other cases are given (formaldehyde, SO_2 and CH_3HCO). Spectroscopic evidence shows that there may be several predissociation levels. The case of the photochemical dissociation of N_2O is finally discussed. J. E.

1415. Addition of Hydrogen Bromide to Allyl Bromide in a Magnetic and Electrostatic Field. R. H. Clark and K. R. Gray. *Roy. Soc. Canada, Trans.* 24. *Sect.* 3. *pp.* 111–114, *May,* 1930.—The composition of the reaction product obtained on the addition of hydrogen bromide to allyl bromide in a glacial acetic acid solution is greatly changed when the reaction is carried out in a magnetic field. This result is quite opposite from that found by Clark and Hallonquist [see following Abstract] on the addition of hydrogen bromide to the unstable electromer of 2-pentene, without any solvent; in this latter reaction a magnetic field had no effect. The two cases differ in that the former reaction was carried out in a polar solvent, the dielectric constant of which was possibly affected by the electromagnetic field. Likewise in the former reaction, the allyl bromide already contains a polar element, which is lacking in the 2-pentene. AUTHORS.

1416. Electromers of 2-Pentene. R. H. Clark and E. G. Hallonquist. *Roy. Soc. Canada, Trans.* 24. *Sect.* 3. *pp.* 115–119, *May,* 1930.—The melting points of the two isomeric 2-pentenes have been determined. Neither a magnetic nor electrostatic field has any effect upon the addition products obtained with hydrogen bromide on the unstable 2-pentene. [See also preceding Abstract.] AUTHORS.

1417. Action of Nitric Acid on Benzoic Acid in Magnetic and Electrostatic Fields. R. H. Clark and R. M. Archibald. *Roy. Soc. Canada, Trans.* 24. *Sect.* 3. *pp.* 121–124, *May,* 1930.—The effect produced on the nitration of benzoic acid by either a magnetic or electrostatic field of the strength employed was not greater than the experimental error in the method of analysis. In this respect the result is quite different from that obtained in this laboratory on the addition of hydrogen bromide to allyl bromide in a glacial acetic acid solution in a magnetic field. [See the two preceding Abstracts.] AUTHORS.

1418. Heat of Formation of Water. F. D. Rossini. *Nat. Acad. Sci., Proc.,* 16. *pp.* 694–699, *Nov.,* 1930. *Bureau of Standards, J. of Research,* 6. *pp.* 1–35, *Jan.,* 1931.—The heat of formation of water is redetermined by a calorimetric method in which the accuracy of the value obtained depends only on the determination of (1) the mass of water formed by the combustion of hydrogen and oxygen and (2) the quantity of electrical energy required to produce the same rise of temperature of the calorimeter and its contents as is observed in the combustion experiment. The value obtained for the heat of formation of 1 mole (18·0156 gm.) of liquid H_2O from gaseous hydrogen and oxygen at 25° C. and a constant pressure of 1 atmos. is 285,775 ± 40 international joules. Using the factors 1·0004 and $\frac{1}{4 \cdot 185}$ for converting, respectively, international joules to absolute joules, and absolute joules to gm.-cal.$_{15}$, this value becomes 285,890 ± 40 absolute joules or 68,313 ± 10 gm.-cal.$_{15}$. A. J. M.

1419. Heats of Formation of Cuprous and Cupric Chlorides. H. v. Wartenberg and H. Werth. *Zeits. f. phys. Chem.* 151. *Abt. A.* 1–2. *pp.* 109–112, *Nov.*, 1930.—The heats of formation of cuprous and cupric chlorides were determined by direct formation in a calorimeter. The salts were formed from the elements in water solution, and the results were corrected for the heats of solution. The results differed slightly from those obtained by Thomsen and Berthelot. The values obtained were: $Cu + Cl_2 = CuCl_2 + 50 \cdot 8 \pm 0 \cdot 4$ and $Cu + \frac{1}{2}Cl_2 = CuCl + 32 \cdot 1 \pm 0 \cdot 4$. The latter value is in agreement with that obtained by Noyes from the e.m.f. of the cell (Pt)/H_2,HCl/CuCl/Cu at 15° C. F. J. B.

1420. Thermal Transition of Para-Hydrogen. A. Farkas. *Zeits. f. Elektrochem.* 36. *pp.* 782–784, *Sept.*, 1930. *Zeits. f. phys. Chem.* 10. *Abt. B.* 6. *pp.* 419–433, *Nov.*, 1930.—The thermal transition of parahydrogen in clean quartz vessels proceeds in the homogeneous gas phase. From the relation of the velocity of reaction to the pressure the mechanism $H_2^p + H \rightleftarrows H + H_2^o$ is suggested for the reaction. Thus, the transition should follow impact of an H_2 molecule with an H atom of thermal origin. The mechanism may be regarded as a substitution reaction, a free H atom being exchanged for a combined one and para- and ortho-molecules formed in the proportion 1 : 3. According to quantum mechanics, such process should involve a transition, since the symmetry of the whole condition is maintained. Both the dependence on temperature and the absolute value of the velocity yield low values for the heat of activation of this substitution reaction, namely, 4200 and 11,000 cal. respectively. The acceleration of the transition by rise of temperature is produced mainly by the accumulation of the H atoms, the heat of activation having only a slight influence in this direction. T. H. P.

1421. Concentration Cells in Ethyl Alcohol. Part V. Cells Without Liquid Junctions. J. R. Partington and H. G. Simpson. *Faraday Soc., Trans.* 26. *pp.* 625–634, *Nov.*, 1930.—The liquid junction potential in the cell, Ag/AgI, NaIc_1/NaIc_2, AgI/Ag, in ethyl alcohol solution, may be eliminated by separating the two sodium iodide solutions by means of (*a*) a saturated potassium thiocyanate solution, or (*b*) a double-flowing sodium amalgam electrode. The e.m.f. of the cell is found to agree with the formula $E = \nu \frac{RT}{F} \log_e \frac{\lambda_1 c_1}{\lambda_2 c_2}$, where λ_1 and λ_2 are the equivalent conductivities of the sodium iodide solutions of concentrations c_1 and c_2, ν being equal to 1 in the case of (*a*) and to 2 in the case of (*b*). By assuming the formula $E = \frac{2RT}{F} \log_e \frac{f_1 c_1}{f_2 c_2}$, in which f_1 and f_2 are the activity coefficients of the sodium iodide in the solutions of concentrations c_1 and c_2 respectively, for the e.m.f. of the cell with the amalgam electrode, the equation $-\log_{10} f = 1\cdot6\sqrt{c} - 2c$ is obtained for the activity coefficient of sodium iodide in ethyl alcohol solutions of concentrations between 0·1 and 0·01 mol. per litre at 25° C. It is concluded that sodium iodide is not completely dissociated in the solutions investigated. [See also Abstract 2980 (1930).] T. H. P.

1422. Ionisation Constant of Water at 25° C. E. J. Roberts. *Am. Chem. Soc., J.* 52. *pp.* 3877–3881, *Oct.*, 1930.—The ionisation constant of water at 25° C. was determined by measurements of the e.m.f. of cells without liquid junctions. The electrodes were of the second kind, and were immersed in the common solution which contained ions requisite to the reversibility of both electrodes. The e.m.f. measurements led to the value $0\cdot988 \pm 0\cdot004 \times 10^{-14}$ for the ionisation constant of water at 25° C. A method is developed for the determination of the ionisation constants of weak electrolytes, by employing cells without liquid junctions. F. J. B.

1423. Behaviour of Electrolytes in Mixed Solvents. Part II. Effect of Lithium Chloride on the Activities of Water and Alcohol in Mixed Solutions. R. Shaw and J. A. V. Butler. *Roy. Soc., Proc.* 129. *pp.* 519–536, *Nov.* 3, 1930.—An air-bubbling method is described for determining the partial pressures of alcohol and water in mixed solutions, the volume of air required being less than 2 litres. Measurements at 25° C. of the partial vapour pressures of water-alcohol solutions containing from 0 to 100 % of alcohol and lithium chloride at the concentrations 0, 0·5, 1·0 and 4·0 *m* show that the lithium chloride lowers the activity of the water and either lowers or raises that of the alcohol, according to the composition of the solvent and the concentration of the chloride. The fractional lowering of the vapour pressure of water is always greater than that of alcohol. The relation between the relative activities of both water and alcohol and the molar fraction of alcohol in the solvent is approximately linear when the lithium chloride concentration is constant. The effects of the solvation of ions by alcohol molecules and the salting-out of alcohol may be distinguished approximately by the interaction of the ions and water. T. H. P.

1424. Colorimetric Investigations of Indicators in the Presence of Neutral Salts. N. V. Sidgwick, W. J. Worboys and L. A. Woodward. *Roy. Soc., Proc.* 129. *pp.* 537–549, *Nov.* 3, 1930.—The colour exhibited by a definite concentration of an indicator in a solution of given H-ion concentration is changed by the presence of neutral salts. The evaluation of this neutral salt effect, determined by a colorimeter employing a rubidium photoelectric cell, supplies information relating both to the dissociation of the indicator (methyl orange) in salt solutions, and to the dissociation of other substances in the presence of neutral salts. The value of the dissociation constant, K, of methyl orange in HCl solution was found to be $3\cdot03 \times 10^{-4}$ at 18° C. The value of K, in the presence of NaCl rose from $3\cdot03 \times 10^{-4}$ for $0N$ salt concentration to $3\cdot75 \times 10^{-4}$ for $0\cdot05$–$0\cdot1N$ concentration and thereafter decreased to $0\cdot502 \times 10^{-4}$ for $3N$ salt concentration. The value of $[H_{\text{free}}]$ was found to rise with increase of salt concentration in the cases of the chloride, bromide, chlorate and nitrate of sodium, and the chloride and bromide of potassium, attaining

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a maximum corresponding to a concentration $N/2$ and thereafter decreasing. The results are discussed in connection with the conclusions of Güntelberg and Schiödt, Harned and Akerlöf, and the Debye-Hückel theory. So far as effect on the apparent ionisation of the acid of methyl orange is concerned, the order of activity appears to be $NaBr > NaCl > KBr > KCl$.

J. S. G. T.

1425. Calculation of Activity Coefficients from Solubility Measurements. Part II. Thallous Iodate. Part III. Unsymmetrical Valency Type Effect. C. W. Davies. *Chem. Soc., J. pp.* 2410–2426, *Nov.*, 1930.—Continuing previous work [see Abstract 3605 (1930)], it is shown that the activity coefficients found for thallous iodate from solubility measurements become normal when allowance is made for incomplete dissociation. The activity coefficient is independent of the nature of the added salt, for small concentrations of the salt. The activity coefficient for thallous iodate is found to be expressed by the equation $-\log . f = A \sqrt{\mu}$, where $A = 0\cdot47$. The dissociation constant for the $MgIO_3$ ion is calculated to have the approximate value $K = 0\cdot19$. The large deviations from the Debye-Hückel theory of dilute solutions described as "electric type effects" or "unsymmetric valency type effects," are considered to be due to the incomplete dissociation of the salts concerned. Calculations based upon solubility measurements of two luteocobaltic salts in potassium sulphate solutions support this conclusion. F. J. B.

1426. Resistance of Electrolytes at Low Frequencies. J. A. C. Teegan. *Indian Journ. Phys.* 5. 4. *pp.* 463–471, *Oct.* 1, 1930.—The measurement of the resistance of electrolytes at low frequencies was carried out by means of an oscillation circuit based upon the Hartley circuit. The results were compared with h.f. determinations made with a circuit employed by Dowling. It was found that the resistance of electrolytes underwent no change at frequencies of 10^6. Apparent changes are observed when copper electrodes were substituted for gold electrodes, but they are considered as probably due to polarisation or chemical effects.

F. J. B.

1427. Mobility of the Perchlorate Ion in Methyl Alcohol. E. D. Copley and H. Hartley. *Chem. Soc., J. pp.* 2488–2491, *Nov.*, 1930.—Measurement of the conductivities of solutions of lithium, sodium and silver perchlorates in methyl alcohol at 25° C. at concentrations varying from 0·0001N to 0·002N shows that, in each case, the variation of conductivity with concentration is in close agreement with the Debye-Hückel-Onsager theory. The mobility of the perchlorate ion is 70·85, and that of the silver ion 50·3 in methyl alcohol at 25° C. T. H. P.

1428. Lowering of the Vapour Pressure of Water by Dissolved Electrolytes. J. J. van Laar. *K. Akad. Amsterdam, Proc.* 33. 10. *pp.* 1140–1160, 1930. *In German.*—The subject is discussed theoretically with the object of testing the Debye-Hückel theory of strong electrolytes. It is shown that $(p_0 - p)/p_0 x = i - \phi x^{\frac{1}{2}} + \rho x - \sigma x^{3/2} + \ldots$, where for strong binary electrolytes $i = 2$, x is the fractional molar concentration of the solute, ϕ is about 5 at 20° C., and the other coefficients are determined by the known mutual interaction between the components. Association of the solvent is without influence on i and ϕ, but influences the values of the remaining coefficients. The equation has been verified by reference to existing experimental data. H. F. G.

1429. Conductivity of Uni-Univalent Salts in Ethyl Alcohol. E. D. Copley, D. M. Murray-Rust and H. Hartley. *Chem. Soc., J. pp.* 2492–2498, *Nov.*, 1930.—Measurements of the conductivity of a series of solutions of nine uni-univalent salts in ethyl alcohol with the concentration range 0·0001–0·002*N* at 25° C. reveal the fact that the perchlorate ion has a greater mobility than other anions in this solvent. A method is described for preparing ethyl alcohol of suitable purity for conductivity measurements. The water content of the alcohol may be determined by measurement of the viscosity in an Ostwald viscometer, the increase in viscosity caused by small amounts of water being proportional to these; addition of 0·1 % of water raises the viscosity by about 0·4 %. T. H. P.

1430. Form of Kathode Tin. F. Foerster and H. Deckert. *Zeits. f. Elektrochem.* 36. *pp.* 901–923, *Nov.*, 1930.—The effect of the addition of phenol-sulphonic acids to stannous sulphate solutions upon the form of the deposited tin was studied. The addition of meta-cresol sulphonic acid caused the tin to be deposited in a smooth continuous coat, and reduced the tendency to the formation of needles of tin, at right angles to the kathode plane. The action was traced to the presence of by-products which were formed during the sulphonation of the meta-cresol. The amount of these byproducts and their nature was influenced by the time and temperature of the sulphonation. Above 120° C. colloidal products were formed which were carried to the kathode by electrophoresis. The part played by adsorption of the various substances is discussed. The adsorbed substances investigated included various phenols, sulphate of aniline, pyridine and gelatin. F. J. B.

1431. Cataphoresis in Rotating Electric Fields. E. M. Pugh and C. A. Swartz. *Phys. Rev.* 36. *pp.* 1495–1502, *Nov.* 1, 1930.—A new method of making cataphoresis measurements on colloid particles has been developed and tested. The method makes use of a rotating electric field which causes the particles to move in circles. In this way it is easily possible to test the effect of variable speed of the particle on the distribution of the diffuse electric double layer surrounding it. The results obtained indicate that this effect is negligible. Furthermore, it has been discovered that the mobility of the small particles (below 10^{-4} cm. in diameter) fluctuates widely, and this is made very evident to the eye by the fluctuations in the circular paths of the particles. The fluctuations are quite violent with particles as small as 10^{-6} cm. in diameter. Considerable study of these variations has been made as well as an attempt to explain them qualitatively. AUTHORS.

1432. Deposition Potential of Arsenic Sulphide Hydrosol in Presence of Excess of Arsenic Oxide. S. N. Mukherji. *Kolloid Zeits.* 53. *pp.* 159–162, *Nov.*, 1930.—Carefully prepared hydrosol of arsenic sulphide was used for a series of cataphoretic measurements, in which the migration velocities of the colloid were determined. When no electrolyte was present the velocity of the colloidal particles diminished as the concentration of arsenic oxide increased. A similar regularity was observed when the effects of equal coagulation and precipitation concentrations were employed. Curves showing the variation of the cataphoretic velocities with the concentrations of potassium chloride and barium chloride are given. F. J. B.